

Aviation Week & Space Technology

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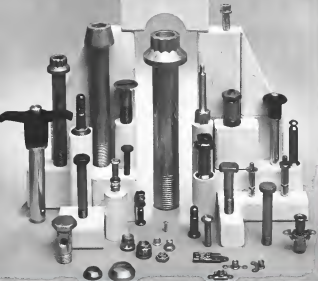
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August 26, 1963

**TFX Program
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**USAF/Sikorsky CH-3C
Rear-Loading Helicopter**





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the shapes
of things
to come
are
formed
every day

Aero Vultair
Max Undercarriage

UNDERCARRIAGES **by DOWTY**

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wade AFB, Calif. Sponsors: American Astronautical Society, Air Force Flight Test Center.

Sept. 19-22—New York University's Third Annual Air Transport Conference, Washington Sports Center, New York, N. Y.

Sept. 12-16—East Coast Convention, New League of the United States, Boston, Mass.

Sept. 14-16-17th Annual National Conference & Aerospace Program, Air Force Area, Shawnee Park and Shawnee Inn.

Sept. 12-13: Annual Joint Engineering Management Conference, Hotel Edison, New York, N.Y.

Sept. 16-18—International Analysis Research and Development Symposium: At Long Beach, Calif. (Sept. 16-18, 1974).

Sept. 18-19—1963 Airwork Operations and Maintenance Symposium, Millville, N. J.

Sept. 19, 2001, Air Force Conference on Environmental Effects on Aircraft Systems, U.S. Naval Air Warfare Test Station, Dayton, N.J.

Sept. 20-21—11th Annual Conference on Communications (Microelectronics). In fields of Electrical and Electronics En-

Sept. 20-29-North Annual Houston Inter-

Sept. 15-16—Symposium on Aerodigestion and

Dynamic Modeling Technology, Siltco-Hillside Hotel, Dayton, Ohio. Sponsors: Air Force Systems Command's Aeronautics

Sept. 23-27—National Aeronautics and Space Engineering and Manufacturing Meeting

Sept. 1947 = International Telecommunications

London, Army Place, London, England; Spence Institution of Electrical Engineers (London), American Institute of Commerce and Information Systems.

of Electrical and Electronics Engineers,
Institution of Engineers
Sept. 14-16-1976 Annual Convention and

Sept. 24-26: Several Annual Symposia on

The Flom Foundation, 1000 North Dearborn, Chicago, Ill. 60610; Spaulding House Air Development Center; Armour Research Foundation.

Sept 25-Oct. 1-14th. Congress, Internal
Tropical Agricultural Federation, Paris

Phys. Seventh Annual Report to the
Academic Professor and Academic
and Academic Hotel, March 1988.

Sept. 30-Oct 1—Married Interdisciplinary Exploration Meeting, American Institute of Aeronautics and Astronautics, College

Sept. 30-Oct. 2—Canadian Electronics Con-
ference, Inst. of Electrical and Electronics

Det. 44-Eighth National Symposium on
Space Electronics, Institute of Electrical

(Continued on page 9)

(Continued on page 9)

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holds probes, tip leads, accessory tubes.
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201-1	100%	250-300, 310A, 310A, 310A, 310A, 310A	Yes	No	White
201-2	100%	250-300, 310A, 310A, 310A, 310A, 310A	Yes	Yes	White
201-3*	50%	250-300, 310A, 310A, 310A, 310A, 310A	Yes	Yes	White
201-4*	100%	250-300, 310A, 310A, 310A, 310A, 310A	Yes	Yes	White
201-5	100%	250-300, 310A, 310A, 310A, 310A, 310A	Yes	No	White

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The PHI 200 is a further development of the Position and Movement Indicator Navigation System designed and developed by Computing Devices of Canada Limited. The PHI system (adopted by 10 Nations of the Free World) have received several orders for their reliability, accuracy, versatility and low maintenance costs.

The Ansonia, built back in the days of the steam of Grand Central Station, is the first of the new generation of steam locomotives. It was the first computerized locomotive of this generation in the early 1950s of the 20th century. It is the first of the new generation of steam locomotives of this generation in the early 1950s of the 20th century. It is the first of the new generation of steam locomotives of this generation in the early 1950s of the 20th century.



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AEROSPACE CALENDAR

(Continued from page 7)

- Oct. 6-7—National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Albuquerque, N. M. Co-sponsors: Los Alamos Scientific Laboratory, AEC Aerospace Operations Office, AF Special Weapons Center, AF Directorate of Nuclear Safety, Spauld Corp., University of New Mexico.
- Oct. 13—Symposium on Fibers and Non-destructive Testing (unpublished), San Antonio, Tex. Sponsored by Southwest Research Institute.
- Oct. 24—National Area of Air Traffic Specialists, Sheraton-Edgewater Hotel, Glendale, Calif.
- Oct. 26—North Atlantic Communications Symposium, Institute of Electrical and Electronics Engineers, Hotel Drexel Union City, N.J.
- Oct. 27—International Air Transport Association Annual General Meeting, Rome, Italy.
- Oct. 31—William Tell 1963 USAF Inter-Vision Weapons Meet, Torrance AFB, Fla. Host: Air Defense Command.
- Oct. 8-18—40th Annual Air Force Science and Engineering Symposium, Air Force Academy, Colo. Research Office of Aerospace Research, AFSC.
- Oct. 8-13—National Airport Conference, Sonoma, Calif. Sponsors: American Area of Airport Executives & University of California with the cooperation of the Federal Aviation Agency.
- Oct. 9-13—The Annual Aerospace Electrical/Electronics Conference, Aerospace Electrical Society, San Francisco, Calif.
- Oct. 12-15—1963 General Conference, Tenth Aerospace International, Mexico City.
- Oct. 18-19—16th Annual Meeting and Conference, Airport Operations Council, Roosevelt Hotel, New Orleans, La.
- Oct. 14-16—Eighty Annual Symposium and Symposium Air Traffic Council Asia, Sofitel Hilton Hotel, Dallas, Tex.
- Oct. 15-18—Eighty Symposium on Ballistic Missile and Space Technology, Naval Training Center, San Diego, Calif. Sponsors: AF Space Systems Div., AF Ballistic Systems Div., Aerospace Corp.
- Oct. 30-31—Earth, Air, and Space Society, American Vacuum Society, Sheraton Hilton Hotel, Boston, Mass.
- Oct. 31—Oct. 21-22—North American Communications Association Institute of Aeronautics and Astronautics-Canadian Association and Space Institute-Royal Astronomical Society, Moncton, N.B. in atrium of Technodome, Canadian, Mass. (Oct. 17-18) Quebec Elizabeth Hotel, Montreal, Quebec (Oct. 17-21).
- Oct. 21-22—Twelfth Annual East Coast Conference on Aerospace and Navigation Electronics, Institute of Electrical and Electronics Engineers, Emerson Hotel, Baltimore, Md.
- Oct. 22-24—Conference on Expandable Structures, National Civil Aircraft Co's Super Camp, Dayton, Ohio. Sponsors: Associated Robots Design, Propulsion and Flight Dynamics Laboratories.
- Oct. 23-26—International Symposium on Plasma Physics and Magnetism, Massachusetts Institute of Electrical and Electronics Engineers, 11 Cortez Hotel, San Diego.



Primary heat exchanger source: Janitrol

The long range high performance Douglas DC-8 with fan engine uses four Janitrol heat exchangers in its air-conditioning system. Located behind the lower air intake in each engine nacelle, these primary exchangers reduce engine bleed air temperatures from 850° to 450°F. Since space is limited the units were designed to be compact and thermally efficient. One unusual qualification requirement is that the exchanger must withstand 5000 temperature expansion cycles. Janitrol is type 347 stainless steel, heat transfer material thickness is 0.0035" (size is 8 1/2" H x 27" W x 16" D).

When you need a heat exchanger or an oil cooler, Janitrol's approach to heat exchanger reliability can be an important design asset. We regularly work in stainless steel and aluminum using plate and fin, dimpled plate, tubular and Plastirol® techniques. Request bulletin JA 216 from the Janitrol Aero Division of Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

17th Midland-Ross Corp.



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Midland-Ross Corporation**

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MIL-MAT RESET COUNTER:

- supports 20 pins
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- -55°C to +100°C operating
- built-in test by D/A/N



SUB MINIMATURE MEMORY:

- 16,384 bit sequential access memory
- synchronous read/write data rate to 20,000 bits/sec.
- volume less than 70 cc. in.
- weight, 25 g. in.
- Read/Write or Read/Write modes
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- 20 mil. thick substrate
- -55°C to +100°C operating
- 20 pin, 16,384 bit and also available
- built-in test by D/A/N

HISTORY: NO ONE (except, in one corner, IBM) is making DI/AN's history of reliability in magnetic logic equipment for space. Proof: The operating history of these devices (and their predecessors) approaches a million hours in over 30 different aerospace programs with no known failure.

RELIABILITY: This, mind you, is a record of actual use of our clock timers, counters, read/write memories, etc. The record is supported by two life tests of the individual magnetic Core Transistor Logic modules (CTL's), with which these equipments are made. The Tests have logged 3 1/2 million module hours over 3 years — no failures, and 1/2 million module hours over 2 years — no failures. These numbers are for complete logic elements — not compare these with numbers for simple components!

THE KEY to this history and reliability: The unique advantages inherent in CTL magnetic logic design — low power

low capacitance, magnetic field sensitive elements, parametric, non-volatile, low static resistance to radiation and to extreme temperatures. Plus, extraordinarily high, fully cabled circuit density. Over 16,000 high logic power CTL's per cubic foot! 1000 CTL's make a possible 60 computer.

SHORT DELIVERY: One type of magnetic logic element is used for all functions — functions determined by interconnection. New equipments are built with almost no electrical engineering time required. Product line units (as listed above) are available on short delivery from current production.

WRITE FOR DATA SHEETS and special report on "MAGNETIC LOGIC IN SPACE" — A REPORT ON HISTORY AND RELIABILITY.

ALSO AVAILABLE: Others covering three other DI/AN product lines: Magnetic Logic and Register Modules and Units • Standard Core Memories • Data Systems.

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FROM FAFNIR... BALL BEARINGS THAT HELP THE NEW XC-142A TAKE OFF STRAIGHT UP

The XC-142A — the first U.S. V/STOL aircraft scheduled for operational evaluation can take off straight up at 5500 to 7500 fpm. Fafnir Duplex Thrust Bearings in the propeller gear boxes help lift the plane's 20-ton-plus loaded weight.

Fafnir engineers applied advanced computer analysis in engineering these bearings for high capacity. SAES2100 consumable electrode vacuum melted steel assures optimum reliability in the high-thrust bearing. The smaller flanged bearing is designed to absorb the lighter reverse thrust loads. Both bearings are 99.999 counterbored type with low-friction, high strength, silver-plated iron silicon bronze retainers.

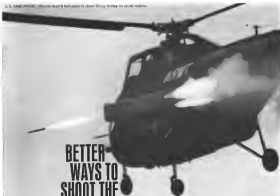
If extra-critical bearing applications pose problems for you, find out how the "computer approach" at Fafnir assures reliability. Remember, "Fafnir on your bearings means sound engineering, highest quality, full value at a fair price." The Fafnir Bearing Company, New Britain, Connecticut.



Fafnir Duplex Bearings take unbraked gear thrust in each of the four outboard gear line assemblies of the XC-142A. Bearings are heat treated for conventional stability at operating temperatures.

FAFNIR
BALL BEARINGS

U.S. NAVY photo: Sikorski HO4E helicopter in down flying landing to avoid missiles.



BETTER WAYS TO SHOOT THE SHOOTS

Whether you're in the "hot seat," in the laboratory or in the tank or in orbit, Truax cameras and accessories can provide zero-zero answers to your photo instrumentation requirements. The gas cameras shown below are ideal for primary evaluation in helicopters or other aircraft. For standard airframe equipment, 10mm or 25mm, coast or Trail for a reliable answer too! All units please meet applicable MIL Specs.



60-270 — WITH AUTOMATIC
EXPLOSIVE CONTROL

The rugged 60-270, made by the combined Truax Corp and Raytheon, was designed by Truax, in a versatile rugged, with a photo cell to measure light levels and a computer to set the shutter. It is ideal for applications where constant electronic set is given to settings and storage. Photo cell and computer may be included away from the camera. Or a dual mount frame with a 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, 2800, 2900, 3000, 3100, 3200, 3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700, 4800, 4900, 5000, 5100, 5200, 5300, 5400, 5500, 5600, 5700, 5800, 5900, 6000, 6100, 6200, 6300, 6400, 6500, 6600, 6700, 6800, 6900, 7000, 7100, 7200, 7300, 7400, 7500, 7600, 7700, 7800, 7900, 8000, 8100, 8200, 8300, 8400, 8500, 8600, 8700, 8800, 8900, 9000, 9100, 9200, 9300, 9400, 9500, 9600, 9700, 9800, 9900, 10000, 10100, 10200, 10300, 10400, 10500, 10600, 10700, 10800, 10900, 11000, 11100, 11200, 11300, 11400, 11500, 11600, 11700, 11800, 11900, 12000, 12100, 12200, 12300, 12400, 12500, 12600, 12700, 12800, 12900, 13000, 13100, 13200, 13300, 13400, 13500, 13600, 13700, 13800, 13900, 14000, 14100, 14200, 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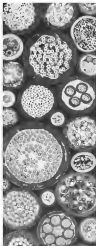
THE THIN BLACK LINE. On your schematic, instrumentation cable is a black line from headboard post to blockboard or from one part of a computer to another. In the broadest sense, it conveys data or signal sources with delay in reaching or control devices. Its function is to carry these signals unfailingly and with the required reliability. In this day and age, it's no easy job.

WHAT CAN GO WRONG. The improperly designed cable can simply fail. This has happened and at important sites. An unshielded signal, induct or coupled signal and in the cable may destroy the electrical integrity of the primary system. This sort of deterioration need not be sudden; only experts know when degradation will require a week or a month or more.

Or a relative lack of art in installation may create problems like this. Under certain circumstances in use, variations in insulation thickness, conductor placement, or conductor insulation in the cable layout may cause spurious or ambiguous signals to arrive at the display, recording or control panel. Your cheap price may become degraded in time, as a little too fast, or too slow by other unwanted signals from another line.

DESIGN IS HALF THE STORY. Configuration of conductors within the cable is important, for physical as well as for electrical reasons. For example, positioning of control components within the cable is critical in order to assure maintenance of minimum standards of conductivity between the inner and outer conductors when the cables may be subjected to bending operations during installation work.

Selection of shielding, filler and



insulating materials requires expert knowledge and judgment. Some materials, as mentioned above, tend to migrate. Others soften or soften with cold or heat. Some change their electrical characteristics in time. These are not fundamentally new problems in cable design, but in instrumentation cable the standards are far more severe than ever before.

MANUFACTURE IS THE OTHER HALF. Even a properly designed cable may well become unserviceable merely due to poor manufacturing to new standards of precision. This requires winding machines that reduce circular eccentricity to amazingly low figures and help assure insulation uniformity, insulating machines of considerable precision, and highly precise cutting equipment. It also requires, as is so often the case in precision manufacturing, an indefatigable skill on the part of machine operators.

ASK THE EXPERTS. To protect the future of your system, there's only one way to make sure the dust black from your schematics become cables with the highest dependability: have them designed by experts in consultation with you, and constructed by experts.

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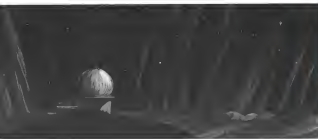
We now have a 24-page booklet titled "Instrumentation Cables, Cable Assemblies and Hook-up Wires." In it, we describe instrumentation cable construction, production, industry specifications and our qualifications. For your copy, write Rome Cable Division of Alcoa, Dept. 25-81, Rome, N.Y.



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1933 target vehicles on a highway



1963 target: vehicles in space

Thirty years ago, Westinghouse engineers in East Pittsburgh learned radio waves from the planet soil and detected moving autos a clock away. They didn't call it "radar"—the word hadn't been invented yet.

Radar development at Westinghouse has involved many paths since 1933. Defense Center scientists have consistently pioneered in advancing the art—from the rooftop experiments to detecting enemy

planes approaching Pearl Harbor to tracking vehicles in space.

Systems in action today include radars for airborne and space missions, search and weapon control, tactical and fixed air-defense, shipborne and ground-based acquisition and tracking. Typical of current projects at the Westinghouse Defense Center are the AN/SPG 59 shipboard fire control radar for the Navy's TYPHOON program and the land-based

AN/FPS 27, a long-range air defense radar in the Air Force's SAGE system.

Continuing Westinghouse leadership in radar research and development emphasizes a unique capability for the future. It is a capability to be rekindled with its early serious discussion of advanced radar systems. Write to Westinghouse Electric Corporation, P.O. Box 505, Pittsburgh 30, Pennsylvania. You can be sure if it's Westinghouse.

Circle 4

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Higher and higher recording speeds mean instrumentation progress—and problems! Increased speed and tension on tape generates forces that concentrate heat around recording heads and can make ordinary tape variable signal dropout or distortion one result when the localized, high-temperature, built-up separates recording media from tape backing.

"Scotch" brand Heavy Duty Instrumentation Tapes carry signals coolly through head-heat environments. They withstand temperatures from -40°F up to +250°F. They last at least 15 times longer than ordinary tapes. Their heavy duty oxides and binders are formulated to resist heat extremes, moisture, rub-off. Exclusive Silicone lubrication eases head wear, tape wear. They offer 1000 times more conduc-

tivity than ordinary tapes to drain off heat-gathering static.

16 different "Scotch" Heavy Duty Tapes are available in 3 sizes. Polyester backings offered are .60, 1 and 1.5 mils. Choice of coating thickness includes 18 and 40 mils. "400" series: excellent high and low frequency resolution. "500" series: smooth, sharp resolution for broad-band, other high frequency uses. "900" series: ultra-smooth surfaces for preselection recording systems, critical wide band needs.

TECHNICAL TALK Bulletin No. 3 explains temperature effects on recording tape, discusses heavy duty oxide and binder combinations. Free. Just write 3M Magnetic Products Division, Dept MCJ-83, St. Paul, MN.

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Volume 79
Number 9

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Aviation Week

& Space Technology

August 30, 1968

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EDITORIAL

Other Side of the Coin

(For the first time in *National Aeronautics and Space Administration's* history, it is meeting strong challenges to its budget. Last week, a House appropriations subcommittee headed by Rep. Albert Thomas (D-Tx.) began an even more thorough scrutiny of NASA's Fiscal 1965 requests than other congressional committees have made (see p. 25). The degree of support in some quarters for the critical approach is well illustrated by a recent public letter from Thomas J. Rice, legislative manager of the U.S. Chamber of Commerce to Rep. Thomas calling for \$1.2 billion cut in NASA's \$5.7 billion request. To assist its readers with the kind of opposition the space budget faces, *AVIATION WEEK & SPACE TECHNOLOGY* presents excerpts from Mr. Rice's letter.)

The Chamber of Commerce recommends that this [the NASA request] amount be reduced by \$1.2 billion and that a total of \$4,512,000,000 be appropriated for NASA programs for Fiscal 1964. We believe this amount will adequately provide for a continuation of our national space program and will enable the space agency to meet the established goal of a manned lunar landing by the end of this decade. The amount we recommended will give the space agency an approximate 25% increase in appropriations over Fiscal 1963, which is the average growth rate we believe can be sustained and supported within the economic as well as scientific and technical capabilities of the nation.

There is reason doubt as to the ability of NASA to spend wisely or properly manage the proposed increase in new obligations, authority and expenditures. The National Defense Committee of the Chamber, after a careful analysis of the requested budget, concluded that approval of the proposed increase might actually impede our present space efforts. Evidence submitted to the Committee indicates that there are not enough highly qualified scientific and technical personnel available, other than through a crash program which might well entail actually reducing this scarce resource, to carry out the accelerated program envisioned in the Fiscal 1964 budget.

Since May of 1961, NASA has increased virtually everything it has asked in the way of financial support. This congressional and public support was largely due to test elements and because it was necessary to start a number of program elements to established goals and to winning the so-called international space race. A significant portion of the overall program, Project Mercury, has been completed and we are well on the way to the next steps which will culminate in Project Apollo.

Although detailed information was not available, chamber committees have made a thorough analysis of the authoritative hearings and reports of both the House and Senate.

Several areas of additional savings that we recommend for your consideration include the following:

• **Lack of coordination in the Space Program.** Hearings on the NASA authorization bill brought out a definite lack of coordination and cooperation among the various agencies of the government in areas of mutual interest

related to the space program. Also of concern is the lack of communication between agencies having similar research and development programs to the point that duplication of research effort and facilities is virtually impossible to overcome or eliminate. The Appropriations Committee should examine similar research programs for evidence of duplication and reflect its appropriate funds for operation of such programs. Specifically in the areas of: aerospace medicine [and] human factors systems.

Probably the best single example of duplication of effort occurs in the field of meteorological research and development. Of the 14 agencies involved in weather research, NASA, the Weather Bureau, the National Science Foundation, and the Department of Defense were all found to be involved in basic research.

• **Coordination and Use of Facilities.** Because construction of facilities must necessarily depend on approval of programs and projects for which they are required, we do not make any specific recommendations for reductions in the appropriations request. We do believe, however, that the Independent Office Appropriation Subcommittee should carefully scrutinize each request to determine if it is justified.

• **Electronic Research Center.** We believe the additional authorization requested by the House Science and Astronautics Committee to be the maximum recommended before any funds are appropriated for the Electronic Research Center. We note that the Senate Aeronautics and Space Sciences Committee deleted the requirement for construction of the proposed Center and required only additional information on the location. We cannot support this position and urge that the Appropriations Committee not appropriate funds for the Center until the proposed congressional committee has received the information requested by the House and have submitted their findings to NASA.

• **Administrative Operations.** A major portion of this request is for personnel compensation and personnel benefits to pay the salaries of a year-end total of 31,300 persons. This represents an increase of 3,955 positions over those authorized in Fiscal Year 1963. Every effort should be made to meet further increases and we would hope that the appropriations committee could find ways to reduce further this request.

• **Facility, Training and Research Costs.** It is high time that Congress took a long look at the proliferation of federal programs in the educational field and the tremendous increase of federal expenditures. At the present time, there are more than 40 government agencies with subsidies for educational programs with no means of coordination to insure that training appropriate to our country's needs is pursued.

The \$30.6 million authorized by House action will enable the space agency to continue its current program of facility, training and research grants and would result in a leveling off of the program which threatens to increase further in subsequent years.

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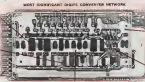
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WHO'S WHERE

In the Front Office

William A. Ray, board chairman, and George K. Bryant, president, ITT General Controls, Inc., Clinton, Calif.

Stanley B. Kaufman, vice president managing, Raytheon World Airways, Inc., and W. Wally Lynch, vice president-engineering, also John G. Rogers, chief engineer and Dallas Sherman, account executive.

High Buckingham has joined the board of Hawker Siddeley International Ltd., London, England, as director for research and development for sub-construction contract avionics products. High Buck has joined the board of Hawker Siddeley Holdings Ltd., he will continue as managing director.

George Leggett, Jr., a senior vice president, Raytheon Co., Lexington, Mass., and a director. Mr. Leggett is the company's chief financial officer.

Art Vito Menzies I. C. Crockett (RCAF, ret.), a vice president at Canadian Ltd. in charge of European Operations with offices in London, England.

William F. Baker, vice president-Raytheon, Aero-Gas Avionics Corp., Alexandria, Va.

James V. Schuler, a president of Pan American-Cross Airways, Inc., he will head the corporate development and finance division of the Miami office.

J. F. Chaudhry, corporate secretary, Midway, Inc., Palo Alto, Calif.

James D. Wright, former group vice president and a director at Ford Motor Co., has been named a consultant in Los Angeles, Beverly Hills, Calif.

Honors and Elections

The Mackay Trophy has been presented to the crew of the Air Force's C-141 Starliner for its record flight of Mar. 5, 1962, which embarked a new Los Angeles-New York flight time of 2 hr. 18.7 min. after an en route stop at New Orleans. The award commander, Capt. Robert McDonnell, awarded Capt. John T. Wilson, the crew chief.

The Air Force named William A. Ray for Outstanding Achievement for developing a new avionics electronic product that major has been presented in the following list of engineers from Hawker's Avionics Division and Military Division: Group Research Dept., William E. Richards, A. Brown, James J. Brown, John J. Lewis, David L. Fane and Richard J. Ridd.

Changes

Don E. Walcott has joined the staff of Lincoln Optical Systems, Inc., Pasadena, Calif., as a senior consultant in optical systems engineering. Also Edward M. Dugan, a senior consultant in optical systems development and engineering.

Dr. M. Stuart White, Federal Air Force, FMA, Washington, D.C.

Raymond Gagnier has been named as a member, field installation of Lockheed-Martin & Space Co.'s Mechanical and Mathematical Sciences Laboratory, Palo Alto, Calif.

(Continued on page 12)

INDUSTRY OBSERVER

► Negotiations for a \$10-million B-55K modification program are under way at Ogden Air Materiel Area, 140 AFH, Utah. Approximately 40 aircraft, like the initial program, are modified by De Mott Engineering (AWR 118 p. 64) would be purchased for conversion program (COTD) surface operations. Several companies besides De Mott are bidding on the program.

► Sikorsky CH-53A twin-turbine helicopter will be demonstrated to USAF's Air Rescue Service at Orlando, Fla., Aug. 28 in a possible rescue and recovery vehicle for operations. Air Force has ordered the CH-53C (S-61) acquisition program (see cover) as its long-range support helicopter (AWR July 8, p. 12), and most of these helicopters may go to ARS (see p. 19).

► Air Force wing commander, Pacific Air Force, have generated requirements for 40-50 Fairchild C-125B conversions, now General Electric J55 turboprop engines, no new engines, in addition to the Pratt & Whitney R-3500 reciprocating powerplants currently carried. Approval and funding of the program still is uncertain, however. Maintenance and operating funds, the source for such a modification program, are heavily committed to the B-52 modification program for Fiscal 1966 (see below).

► Hawker Siddeley is negotiating with Atlantic Aviation Corp. and Air Research Aviation Service Co. for sale of the de Havilland DH-125 executive jet in the U.S. Meetings were scheduled in this country over the weekend, and an agreement may be announced this week.

► Part of the first batch of 16 de Havilland Caravelle transports is expected to be flown from Canada to India in September. Since the start of the Sino-Indian conflict last October, Canada has supplied India with eight C-74s, five Otters and 36 Harvard aircraft. This assistance has been made a valuable partly as an outright gift and partly as loan at reduced interest.

► Considerable noise reduction research appears to be necessary before VTOL conversions, such as the 1000-lb. Air Force's XC-142A, would be permitted to operate from pads located near cities or other densely populated areas. Indications are that the popular noise levels generated by the XC-142A on takeoff would be similar to a Conquest on takeoff.

► Development of photoconductive materials to produce visible images almost instantaneously after exposure will be completed by the Avionics Research Systems Div. The technique, which will enable a new method of processing, would be designed to provide an image for automatic assessment within 5 sec after exposure. Proposals are to be submitted by Aug. 29.

► Range safety studies conducted at both Atlantic and Pacific missile ranges indicate that the present restrictions on launch vehicle launch altitude at both ranges were lifted, the launch to populated areas in the U.S. would be no greater than that covered by test launch operations. The limits of launch altitude have imposed severe restrictions on many U.S. space efforts.

► Modification program for USAF's Boeing B-52 bombers will taper off in the current fiscal year, as a \$10.6 million was requested for completion of 15 changes ranging from structural loading of the wings to automatic checkout equipment for the electronics system. Most active part of the modification program was Fiscal 1962, when \$260 million was asked for initially and another \$10.6 million was requested later. In Fiscal 1963, \$312 million was requested. Total requested for the three years was \$374.6 million.

► Federation Aeronautique Internationale has certified as a world record the speed of 353.818 kph (157.6 mph) set last May by a Russian two-engine Mi-2 helicopter over a 3000-m, closed course. The Soviets had chased a week of 64 kph for the Mi-2. Previous record for the helicopter in the 1,736,000 kg (3,816,000 lb) class was 445.1 mph set in 1961 by an An-2/Bell UH-1 Inspector.



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Washington Roundup

Perilous Passage

In all of its perilous passage through Congress since hearings began last February, National Aeronautics and Space Administration's \$4.7-billion budget request has received nothing like the rough treatment it's getting from the House Independent Offices Appropriations Subcommittee. William W. Cline, Jr., director of the Marshall Space Flight Center and Dr. Wilbur F. Scheraga, head of the Jet Propulsion Laboratory—emerged from the subcommittee's closed hearings last week somewhat shaken by the experience.

House Appropriations Committee probably will recommend a NASA budget for fiscal 1964 of about \$5.2 billion. The Senate Appropriations Committee is expected to vote a \$5.4- or \$5.5-billion budget and the appropriations will have to go to a House-Senate conference committee for resolution.

This is what happened to legislation which authorizes NASA spending for fiscal 1964. The House approved a \$5.2-billion increase and the Senate \$5.5 billion. For a while, it looked as if conservative Republicans would succeed in a legislative maneuver which would have denied the House members to hold the line for a \$5.3-billion authorization (AW Aug. 19, p. 25). Rep. James Fulton (R-Pa.) and he succeeded in convincing the House Republican leaders that this would leave out the guts out of the space program.

Although the authorization bill recommended by the conference committee probably will come out at about \$5.4 billion, the real threat to the NASA budget is the House Appropriations Committee. Right now it looks as though NASA won't and up with an appropriation of more than \$5.2 or \$5.3 billion.

Soviet Space Flight

U.S. space scientists, who have never taken Sir Bernard Lovell's pronouncements on the space race too seriously, are even more skeptical of the British astronomer's statements that the Soviet Union may have canceled or slowed down its manned lunar landing program. In announcing the full cancellation of the Vostok 1 and 4 group flight (AW Aug. 30, 1962, p. 26), Soviet officials said their manned flight program would lead to landing cosmonauts on the moon. Then Soviet Cos. Nikolai P. Kamanin said last week that Cosmonauts Yuri Gagarin and Gherman Titov are preparing for a flight "very soon."

William M. Hawken, Lockheed Aircraft Corp.'s vice president for science and engineering, is considered a leading candidate for assistant secretary of the Aeronautics and Development, a post vacated recently by Fred J. Losen.

Supersonic Transport

Selection of Eugene R. Black as a special adviser to the President on the financial aspects of the supersonic transport (SST) (AW Aug. 19, p. 37) without consulting N. E. Hinkle may indicate, White House disenchanted with the FAA administrator's leadership in the SST program. Hinkle received word of the appointment only shortly before the official announcement was released at the White House.

Black's prime mission is to evolve a program which will soften industry opposition to a requirement that it underwrite 25% of the cost of developing the aircraft. Black probably will recommend that the government pay the entire development cost.

In an effort to keep abreast of the British and French in the supersonic transport race, the FAA last week took the unprecedented step of opening 21 foreign flag carriers to have a sales pitch on the U.S. market. Gordon M. Bess, FAA deputy administrator, stressed U.S. experience in building supersonic military aircraft and the construction of safe and profitable commercial planes. He also mentioned earlier studies that the U.S. is not far behind the British-French Concorde program.

Happy Birthday to Me

Aerospace Industries Assn., the American Institute of Aeronautics and Astronautics and the Aeronautics Space Workers Assn. have announced they will sponsor a \$100,000-a-year anniversary dinner for NASA on Oct. 5—in response to a polite and subtle suggestion that originated within the manned agency itself.

Friends of Lt. Col. John A. (Shanty) Pover have called the help of Rep. Albert Thomas (D-Tex.) to make sure that NASA gets Col. Pover in charge of the agency a \$600,000 1964 "Wishy-Ten" exhibit and educational program. Col. Pover's cap upon on the agency indicated he would have the "Wishy-Ten" gift to him the day of his 1964 reassignment as director of public affairs for the Manned Spacecraft Center, but that the agency now wants to put him in a less attractive job.

—Washington Staff



USAF/LOCKHEED C-141 STARLIFTER transport's extreme length of 148 ft., nose to tail, is evident in side view (left). Payload compartment



is 31 ft. long. View through nose access door (right) shows size of interior. Doors can be opened in flight for airdrops of paratroops and supplies.

First C-141 Rolled Out; Production Rate Of Seven Planes Monthly Planned by 1966

By James R. Ashlock

Atlanta—Production rate for the USAF/Lockheed C-141 Starlifter jet transport is planned to reach seven aircraft per month by 1966, based on the current total military order for 132 planes.

Full scale production of Lockheed-Georgia here will not begin, however, until the first full production aircraft has received dual certification to meet military and Federal Aviation Agency requirements.

Learning for commercial use is scheduled for January, 1965, following a 13-month certification program costing approximately \$10 million. The Air Force anticipates that the C-141 will be operational by the fall of 1964 with the delivery of the fourth plane. The first full squadron will be delivered to Military Air Transport Service (MATS) in June, 1965.

The production contract call for the first flight of the aircraft by the end of this year, and Lockheed officials here are so confident in meeting that schedule that operators stem from the program being on schedule to the point.

"The first complete aircraft was rolled out last last week at the Lockheed-Georgia plant. The rollout was two days ahead of the contract schedule, which called for the plane to leave the assembly line by the end of August. It was four days ahead of Lockheed's own schedule, which itself had set the rollout for Aug. 26."

"The contract schedule we had in so tight that we'd stick very close to it without any slippage of our own," Charles S. Wagner, vice president in

charge of the C-141 program, said. "But we did not cut corners for a week ahead of the contract rollout date to give us an extra week to work on."

Specific amount of money involved in the contract has not been disclosed, but Wagner said it is a three-price incentive agreement covering cost, performance and schedule targets.

The rollout ceremony was televised by closed-circuit television screens by President Kennedy. He opened the rollout doors by remote control from Washington. The C-141 was among the first major contract awards to follow Kennedy's inauguration.

Political interest in the C-141 was evidenced by the appearance of the entire Georgia congressional delegation with Kennedy on the rollout.

The rollout was slightly longer than originally expected, since less members of the 12-man congressional group presented themselves. Georgia congressmen have been close to the C-141 program since its inception. Sen. Richard B. Russell is chairman of the Senate

Air and Space Committee, and Rep. Carl Vinson heads the House Committee on Armed Services.

Lockheed's maintenance of the C-141 contract schedule has been aided by the fact that the aircraft has been subjected to very few design alterations during development. One major change involved the engines. Originally, the Pratt & Whitney JT1D-3 powerplant, with 18,000 lb. thrust, was specified. Shift to the P&W TF33-F-7, with 21,000 lb. thrust, came after the contract award, but the change caused no delay, since engine availability and testing had coincided with the aircraft development schedule.

Threat of an eight-week delay arose early when a long day for the control housing was needed during the cooling process. Long from the day were needed for the first assembly stage involving the wing root and landing gear assembly points. The day consists of four good pieces weighing a total of 5,500 lb.

However, Wagner said, subsequent program was such that the eight weeks required to get a replacement for the wing root and an on time schedule was made.

Sixty per cent of the C-141, by weight, was subcontracted (AW Oct 9, 1961, p. 50). Lockheed was concerned that such widespread production might result in improper fittings once the varied assemblies were returned to its main plant for fitting. A decision was



CLOSE SPACING OF ENGINES is shown in C-141 forward view. Wings have 1.7-degree, negative dihedral to prevent Dutch Roll. Tips, which tilt, are 42 in. before the root, but rise 30 in. during flight. Wings are swept back 7.5 deg.



VIRTUAL DISPLAY INSTRUMENTS, including engine gauges, altimeters and engine exhaust pressure data indicator, are on virtualized flight control panel for C-141 pilot.



SMOOTH LINES characterize the casing for the C-141's Pratt & Whitney TF33-P7 turboprop engines. Unlike earlier on-line P&W forward fan propellers, primarily used on the B-57, after a redesign only the fan exhaust meets the structure and exhaust it at the rear with the turbine pump.

made to supply subcontractors with master components after their specifications were, and to require that the master be duplicated without extremely close tolerances.

"It was a good decision," Wagner said. "For example, the tail assembly fit so exactly that we joined it to the fuselage in only 21 hr."

Use of the project type management system, which provides for assignment of specific personnel to the program and sets across traditional functional management lines, was the most extensive at Lockheed's experience. This organization, drawn from Lockheed-Georgia departments and from other company divisions as well, reported to Wagner,

who served as the single Lockheed point of contact with the Air Force Singlepoint Authority for the C-141. Singlepoint Program Office (SPO) at Wright-Patterson AFB, Ohio, where Col. M. R. Blomstedt directs military participation in the C-141 project (AW June 11, 1982, p. 56).

Col. Blomstedt strictly maintained the single point contact as the military side of the program management, so that all military action on the airplane's design were fed into his office and not independently to the contractor. Lockheed credits this restricted role of communication as a major factor in keeping the program on schedule.

The C-141 test program is already

under way. The second assembly on the line was designated for static tests and is now in the dock where static tests are performed. Static tests call for ultimate destruction to learn durability beyond design limits. Evaluation of the fuselage structure will be performed in a 360-100 g static water tank where pressure up to 112.5 psi will be applied to the interior of the aircraft.

Certification by the FAA requires that the airplane be proven durable to within 50% of its ultimate stress limitations. The airplane's standards in this area are somewhat lighter, due to mission requirements but USAF's aircraft also will be certified in early 1983.

The aircraft is designed for 2.5 g load stresses in normal operations and up to 3.5 g in light load conditions. Lockheed emphasizes on the C-141 as a commercial cargo transport, a compromise, although the primary effort currently is directed toward fulfilling military requirements. The main objective is to develop the all-weather operations among airline officials that any aircraft designed strictly for military use is a candidate for commercial applications.

The airlines are expecting that the C-141, which will be called the L-200 in its commercial version (AW Oct. 29, p. 44), has range and cargo volume limitations compared with such current freighters as the Boeing 747-200C and the Douglas DC-87.

Lockheed officials say they are now working with their customers toward resolving these limitations. B. B. Moore, who is in charge of L-200 sales, and studies an under way which hopefully will lead eventually to an aircraft capability for carrying a 90,000-lb payload (AW).

Harvest of military equipment would also facilitate moving the forward bulkhead up another 45 ft, Moore says, increasing the L-200's cargo compartment length to 55 ft. This would help overcome some of the volume shortfalls, he said.

Airline officials are also questioning whether the TF33-P7 engines are needed in commercial operations. An engine with less power would naturally save weight, and would be more economical in maintenance than the TF33-P7.

"What we could do is remove it to simplify design the engine," Blomstedt said, "perhaps down to 18,500 lb. One thing is, at the lower power setting would substantially reduce the maintenance requirement and eliminate the modifications involved in putting other engines on the airplane."

Airline officials of the available freightage have caused Lockheed to stop emphasizing the L-200's reduced need for ground support equipment. The L-200's rear loading ramp is the same height as the ground support truck bed—18 in. But the airlines are al-

ready buying the lift and special trailers for loading and unloading the passenger jet freighters, so we can't fully about savings in that area anymore," Moore said.

Lockheed already wants to avoid an engine, and costly, modifications to the original L-200 design. The engine proposed, the aircraft can probably be offered for \$6 million, approximately \$1.5 million below the cost of competing aircraft.

The company is still convinced that by the time the L-200 is ready for customers, the need for a tailored cargo aircraft will have evolved.

"We would hope that the airlines are going to eventually need to put the freighters they're buying now into the cargo service, assuming that the passenger business is going to expand," Moore said. "They'll need freighters to handle the cargo business that has built up on that happens, and the L-200 can meet that need."

General Electric Wins Biosatellite Contract

Washington—General Electric Radio Systems Dept. has won a \$19 million space agency contract to develop and produce an flight and one ground-based models of the biosatellite, a recoverable payload will carry ecological and biological specimens in earth orbit for periods of up to 30 days.

The flight payload will be made in two configurations. A three-axis model will weigh 500 lb and the larger downwind model will weigh 1,300 lb, in space.

Although National Aeronautics and Space Administration specifies a Thor Delta launch vehicle for the mission, payload weights may require changes in specifications or the use of a Thor Agena vehicle.

A first suggested Delta (TAO) would have a first-stage Thor identical to configurations in Air Force's Thor-2 program. Thor-2 will use two Thor solid-propellant strap-on engines for extra thrust (AW July 27, p. 20).

The Biosatellite is the first space hardware contract for GE's Radio Systems Dept. since the firm's 1964-66 Thor 2000 contract with the Air Force. That 2000 contract came two years ago. The company has cautioned that the satellite contract will not require new facilities and does not include launch of GE's own satellite, a proposed N. J. Dugan, who headed GE's New York and New Jersey projects, has been named Biosatellite project manager.

The satellite is scheduled for first flight in mid-1984 and will represent a major step in the development of biosatellites in the U.S. since the change from Thor-2 to Delta. Biosatellite will carry about 25 separate experiments.

Saturn, Centaur Launches Slip; NASA Says Problems Are Minor

Two final flights. Boeing team for Vehicle 2 is scheduled to be 180 sec.

Johnson expressed confidence that Centaur will reach its current payload goals despite changes that have added weight and weight to the vehicle. Although the vehicle is being strengthened, it also is undergoing a weight reduction program. Programmed payload is 7,100 lb to the moon, 1,100 lb to the planets and 5,000 lb in earth orbit.

Adding the new thrusts developed by Boeing since it was given Centaur management is a method of ground certification which affords greater about the vehicle's performance. The Leon method is to check the engine with helium, an inert gas, which flows out at launch. Previously, the engine was checked by hydrogens and oxygen which was then removed after launch.

There has been an unofficial correspondence between contractors and NASA centers on which vehicle—Centaur 3 or SA-5—would go first, since the launch of both represent significant milestones in vehicle development because they carry high-cryogenic, hydrogen-fueled, upper stages. Centaur stage is powered by two Pratt & Whitney RL10 engines, each developing 118,000 lb thrust. SA-5 is powered by one of the RL10s.

Delays in the SA-5 launch, which will be a few months ago, had been scheduled for the August, is attributed to a series of minor development problems in the SA-5 stage.

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Japanese Missile Survey

Tokyo—Japanese defense agency will send a five-man team to the U.S. soon for a two-month survey of surface-to-air missiles. The team will help determine whether there should continue to rely on its own missile force or to develop a new missile force to replace the current force. The team will be led by Gen. Masahiko Hata, who began in April 1982.

Japan is already committed to the purchase of Nike and Hawk missiles and the development of P188B missile interceptors. This defense agency will send a five-man team to the U.S. soon for a two-month survey of surface-to-air missiles. The team will be led by Gen. Masahiko Hata, who began in April 1982.

If the Defense Agency decides to develop missile defense, it is a possibility that domestic production could meet some of the needs. However, Japan's present missile manufacturing is weak, but because a decision in favor of missiles may force them to make rapid plans for missile production.

space. This aircraft vehicle is designed for 200,000 lb. of equipment, comprising 4,000 to 5,000 sq ft of floor area. ■ **Star adds.** The subcontractor cited a number of U.S. and foreign aircraft, including the Soviet Blinder bomber, with overhead air inlets, as proposed for design. But the F-111 was a concession to Zuckert that none but the North American F-117 could be compared with the F-111. It said the Blinder is the only one designed to fly above sonic speeds, and it is the difference between subsonic and supersonic speeds that adds to the risk of achieving this design in F-111.

Zuckert commented that the Boeing is "one of the most difficult problems that I think of as being difficult in the Boeing era from the General Dynamics era."

"Here a Boeing. They haven't made a star airplane since the F-26 in 1975. They have never made a supersonic fighter airplane, and then take on the blindest job for themselves."

Although Zuckert rejected the conclusion of a number of previous reports, he struck hard at the testimony of Dr. George Gerard, director of engineering sciences at Allied Research Associates. Gerard said that it was the correct choice of materials, it would be about 75% lighter than steel and it might be better for fatigue problems. He concluded by saying, "It has the distinct advantage of making the plane lighter. In fact, I would speculate that any other material is just negligible."

Commenting on Gerard's conclusion, Zuckert said, "I am absolutely amazed. It is really amazing that a scientist could make that kind of a statement about a metal like titanium."

Zuckert called this testimony "a highly superficial presentation of the use of titanium. I think that the Boeing people have been misled by some of the titanium case now reported."

"He said, however, that Air Force 'has been and will continue to be one of America's strongest supporters. We have retired the best in the Air Force. We have pioneered the research the proof in that sector production began a few years ago as have been far and away the nation's largest use of titanium."

Several executive members had an involved discussion with Zuckert on the proper designation of the F-111. Zuckert said he prefers to call it a "Tactical Support Aircraft," that aircraft designation would be as a fighter aircraft. He said he doesn't want the aircraft to get the bomber name, but reluctantly conceded that it is a "fighter-bomber." ■ **Feb. 15.**

Sen. Karl E. Mundt (R-S.D.) asked Zuckert if he heard that Grumman "may pull out of the contract entirely"

if it does not get approval to assemble the Navy F-111 and at its Long Beach, N.Y., plant. Zuckert said he had not heard the name.

Cosman is general subcontractor to General Dynamics. Under the terms of its contract it provides engineering support for the Navy version, manufacturing a number of components and it assembles the Navy production models. Zuckert said final approval of the split or final production of the operational aircraft would not be made for 12 to 18 months, and approval for this type of

production for the development aircraft is pending his study, on any delay. In the event of conflict of interest, Zuckert responded to questioning by Sen. Carl E. Curtis (R-Neb.) to the effect that he has no knowledge other than new aspects of the involvement of Kraft and Colson in the contract. He said industry. Asked by Sen. Curtis if his future compensation is not dependent on the future earnings of companies that do business with Defense Dept. Zuckert replied, "No, sir, I have no place to go when I get out of here."

DDR&E Will Monitor Briefings

Washington-Defense Dept. officials want to give classified briefings to industry on a regular basis and develop new needs will have to notify the director of defense research and engineering at least 90 days in advance and limit the briefings to firms having a commercial interest in the program. The reasons for the long expected directive (AW/JS 15, p. 25), which became effective Aug. 14, is to prevent industry from being led into "blind alleys" by making serious proposals with no idea, according to Walter Carlson, director of technical information in DDR&E. He said such briefings would result in industry's spending money and effort on proposals which DOD would not approve.

Regulations for controlling control of the briefings come from Russell L. Collette, deputy assistant of defense, who last fall abruptly ordered Air Force to prepare and submit the contents of an industry-wide briefing. Industry and military reaction to Collette's move was so strong that subsequent paperwork at reducing briefing procedures was less drastic, although still within the original Collette memorandum.

Suggestions from industry for incorporation in the directive were sought through the Defense Industry Advisory Committee. The final form of the directive was unanimously approved by industry representatives after a "hotly discussed" session. Carlson said.

Control control will be applied by DDR&E to the 12 to 15 large briefings which are given each year, most of them by the industry. The directive calls them "Advanced Planning Briefings." Control will not be exercised over unclassified briefings, classified briefings related to technical support problems, procurement questions or research and development policies and management, and national, classified briefings on current projects or impending contracts. It is a regular part of the program in use, contractors, and one would expect between any two briefings on the same subject.

Most are some of the provisions of the directive:

• Any material that is not included in an approved briefings program must have advance approval of DDR&E.

• An outline of the briefing must be considered among corporate defense officials and approved by the system to be discussed 90 days before the presentation date. That day before the briefing date a complete draft, including visual aids and other material not relating to current projects, must be submitted to DDR&E.

• Briefings should be limited to firms having similar interests and not organized along broad lines which can have a range of interests. The Navy persisted in this policy by separating shipbuilding, weapons and aircraft briefings.

• It is suggested that briefings be scheduled in an adjunct to meetings of technical societies or trade associations whenever possible.

DDR&E will publish a monthly list of meetings and briefings whose attendance is limited by the sponsoring agency. This list will be classified material in its presentation.

Youngstown Firm Buys 15 Jet Commanders

Order for 15 Aero Commander Model 1121 Jet Commanders has been placed by Youngstown Airways of Youngstown, Ohio, which operates a fleet for 39 independent companies on a lease basis.

Total cost of the order will be approximately \$9,493,000 for the 15 aircraft, which will be delivered over a six-month period beginning in late 1966. They will be operated by Youngstown and its subsidiary, Broken Arrow.

Purchase of the ten-year contract would be made in seven payments. The first group of six aircraft, which has raised a serious decline in the lease company's financial position over the past three years.

Titan 2 Makes Successful Flight

Washington-USAF Mission Titan 2 was launched from Cape Canaveral Fla., Aug. 21 on a 5,600 mi. flight on which the first Gemini radiation detection system apparently was tested successfully.

Titan 2 also carried a scientific instrument and payload by the Air Force Cambridge Research Laboratory to test a contract for the first Gemini radiation detection system apparently was tested successfully.

The flight came less than a week after a contract for the first Gemini radiation detection system apparently was tested successfully.

On Aug. 17, Christopher C. Kraft, director of the flight systems division of the Manned Spacecraft Center, and longplanned operations in the first stage of Titan 2 (AW/MS 4, p. 27) and low thrust in the rocket's second stage still within of considerable concern.

Kraft and an interview at a Blackham, Va., space conference that is covered presentation in the briefing had made had reduced the confidence, which before the modification had hit a peak about 310 sec after lift-off and lasted for about 30 sec. He said there was some question whether the in-flight modification had provided a reliable solution.

Kraft's job and second stage thrust was about 10% below nominal and

second, if not corrected, require a reduction of 700 lb in the Gemini space craft.

NASA officials at Houston and Washington and following Kraft's statements at Blackham that the Titan 2 second stage produced low thrust in "some" flights but that the problem was not a basic one and that "some" flights "were being made. Their statements also said "there have been a large number of Titan flights in which the problem was not evident and which demonstrated an adequate performance level in contrast to the previous flights. Any modifications in the present approach."

NASA officials and the increased presentation had indicated the confidence level and that other modifications would be made during it.

Analysis of data following last week's Titan flight indicated it was "fairly good" (AW/MS 4, p. 27) and that the Titan 2 second stage thrust was "perfect," then said.

News Digest

West German government has purchased 140 Astra gas-turbopropellers under a contract with the German Research for \$246.745. Rockets, purchased through the U.S. Navy will enter Air Force and Air Force flights periodically on atmospheric research flights to be conducted during the International Quiet Sea Year.

The study is the first step in the case of the Astra system is a design government for its own use. Astra has been flown from foreign ranges, but only by the U.S. military services and NASA in cooperation with foreign governments.

BBK has received a \$3.4-million contract from the Marshall Space Flight Center to develop a hardware guidance computer for the Douglas A-10 of the Saturn 5 and Saturn IB rocket. Separate negotiations will follow for development and production of actual flight computers.

American Cable & Radio Corp. will provide the U.S. and of the Washington-Moscow "hot line" circuit under a Defense Communications Agency contract. The International Telephone & Telegraph Corp. subsidiary will provide a full-time radio, telegraph line and will cover incorporating private equipment. Communications will be provided on a standard performance, per-minute, and transmitted from the base at 66 up to.

Gov. Louis Brandeis, former Supreme Court Justice, has been elected to the board of trustees of Rand Corp., Santa Monica, Calif.

Indian air force personnel will be trained in the use of portable radar equipment to be provided by the U.S. government for a post in training exercise this fall by the Indian, British and U.S. air forces. The portable radar will be used for additional training during the exercise and replaced later by permanent installations.

Lockheed-California Co. has laid off an additional 100 employees, mostly engineers, containing a gradual reduction in the company's employment. Employees previously have been alerted by the company that the plant might be bringing the total number of employees decreased since 1951 to more than 500.

General Electric's Missile and Space Div., Valley Forge, Pa., has received \$50,000 contract from the Air Force Rocket Propulsion Laboratory to investigate nuclear fuel storage in space. Study will include chemical, solid and solar reaction tests.

U.S. and Soviet Union last week announced final approval of an agreement to cooperate in scientific and technical programs, provide scientific satellite (Raketa 2) experiments and joint cosmic flights in the 1965 World Magellan Survey (AW/JS 15, p. 27).

Lead Electronics Corp. has subordinated Emanuel M. Segel, vice president-contracts and customer relations, and a conducting a "thorough inspection" of allegations that Segel attempted to bribe a civilian employee of Aeronautical Systems Div., according to Louis Albert, Lead president. Segel was arrested by FBI agents in Dallas Aug. 17 and accused of attempting to bribe Charles Long of ASD to obtain a defense surface board concerning a 36-kilohm negotiated contract. Segel denied that any money was offered or changed hands.

NASA Test Pilot Joseph A. Walker flew a North American X-15 aircraft recently to 351,000 ft. Aug. 12 for a new unofficial world altitude record, but fell short of the planned 360,000 ft. work. Previous X-15 high was 148,000 ft., set July 19 (AW/JS 70, p. 24). Decision on another man-in-atmosphere effort is pending location of flight test data at NASA's Flight Research Center.

North American and NASA made found the price of the Apollo command and service module, constructed at \$11.4 million for the period through May, 1967. Previous \$11 million, 15-day and 10-month periods.

Northeast Decision Sets No Precedents

Removal of carrier from Florida market to force drastic changes in eastern U.S. airline competition.

By L. L. Doty

Washington—Civil Aeronautics Board decision to remove Northeast Airlines from the Florida market [AW Aug 19, p. 37] produces a drastic adjustment in the competitive posture of airlines serving the eastern U.S. but fails to set any standards for the reversal of route competition in future cases.

As of late last week, there was no evidence that Northeast had even the slightest chance of recovering any portion of its lost New England Florida route. Congressional interest in the case has been intense but the chief focus of concern appeared to be on New England regional services.

In any event, proper functioning of the regulatory system prevents Congress from exerting any pressure on the Board. Northeast will file a petition for reconsideration, but even the heart of the majority decision was based on Northeast's inability to attain financial recovery from the route, the decision is set to be changed.

In testimony before a Senate subcommittee last week, James W. Austin, Northeast's president, said emphatically that he did not expect the CAB to provide sufficient subsidy to pay off existing debts—he did say there is no money from bankruptcy for the airline. The Board and its decision that it would grant Northeast subsidy to provide service in New England.

Majority Decision

The Board's majority decision is far-reaching in its implications and reflects the changes in the competitive complexion of the airline industry brought about by the introduction of jet equipment and the changing aspects of air travel markets. But in taking cognizance of these factors, the Board often seems to be aware they will be repeated in future cases. The majority understands the point by stating that the industry has a right to expect guidelines as to the degree of competition which the Board will render in the future.

These elements, coupled with the problems inherent in a temporary carrier, deserve more than the passing attention given them in the majority decision, since many decisions consider them the sole reason behind the demise of Northeast.

Majority decision stated that two Douglas DC-3 jet transports can handle two and one-half days in rotary progression between New York and Miami as can three Douglas DC-3 rotary progressions as the same route with the same number of round trips. The point is allowed to rest with this statement:

air sales and offered the carrier no outlet markets during slack seasonal periods.

• Changing policies of markets is touched upon in the majority decision but without pursuing the issue to such any policy conclusions. The decision notes that when temporary certification was granted Northeast in 1956, the New York-Miami market generated 115,000 passenger miles; that the Los Angeles-New York market D added that in 1962. New York-Los Angeles was generating 195,000 passenger miles that New York-Florida route.

There is strong indication that other major markets are undergoing similar changes. It was not until 1962, for example, that the Board formally recognized a major route supplemental to the New York-Miami route in the passenger market in the so-called NASA Circuit (AW May 6, p. 30).

Policy Elements

Two important policy elements are completely omitted in this case. It is no longer realistic to use traffic forecasts as a basis of making route awards since the changing aspects of markets will distort such forecasts. And the negative character of the industry should not be permanently revised because of the change in travel markets. It is highly possible that the Florida market will undergo itself and that traffic growth, which the majority found to be not matched forecasts, will be restored.

• In his testimony before the Senate subcommittee, Austin characterized a temporary certificate as a "bribe to go home." He stated that the "bribe" takes political expression, says impossibilities of every conceivable type cost more, if available at all—or are acquired on more serious terms and conditions where you contribute a "only temporary."

Although also S. Board, CAB chairman, admitted during the Senate hearings that he did not know what could be done about retaining Northeast on its former grounds, but he hoped the hearings would focus attention on the airline's plight so that no one else would be treated "as shakily as Northeast has been."

Austin stated that only the Board's decision—which he called "unavoidable"—but better informed tactics used by both Eastern and National airlines to

drive Northeast out of business. Malcolm A. MacIntyre, president of Eastern Air Lines, emphatically stressed during the hearings that there had been "any conspiracy" to drive Northeast out of business. He said Northeast had filed a complaint against Eastern with the Board in 1952 on this subject and that the Board staff had investigated and found no basis to proceed.

MacIntyre and staff had jet fuel was being increased in such a way to handle the flow of traffic during the forthcoming Florida winter season.

Seaboard Cargo Pact Approved By CAB

Washington—Civil Aeronautics Board last week approved agreements for the use of blacked-out space by Seaboard World Airlines to three foreign flag carriers but—in the same action—disapproved a similar agreement between Pan American World Airways and Japan Air Lines.

The Seaboard agreements provide for the sale of cargo space on certain transatlantic flights operated by Seaboard to British Overseas Airways Corp., Luft Hansa and Aeroflot (AW July 15, p. 31). BOMC, however, disapproved the kind of one Seaboard-Comair CL-44 all-cargo turbo-prop transport.

The Pan American agreement with Japan Air Lines provides for the open sale of three weekly round trips between San Francisco and Tokyo, and a Boeing 707-320 all-cargo jet aircraft for use by the Japanese flag carrier at a space rate of 33 cents per ton mile.

The CAB found that the changed open arrangement of the Seaboard cargo agreement did not include additional CL-44 aircraft.

In denying the Pan American agreement, the Board said Pan American and JAL are the only carriers with direct carrier rights in the California-Tokyo cargo market.

Seaboard Complaint

Washington—Seaboard World Airlines last week filed with the Civil Aeronautics Board a complaint against Pan American World Airways and United States Airlines, charging that the two carriers had violated the Federal Aviation Act, Sherman Anti-trust Act and the Clayton Act last Act through a joint working arrangement on the sales and services of cargo operations.

Seaboard said it understood that the agreement had not been filed with the CAB as required by the Federal Aviation Act. Specifically, Seaboard charged that the agreement was a "concerted competitive working arrangement, pooling of cargo sales and service resources, to give similar arrangement, division of markets, exclusive dealing arrangements, agreements not to compete."

BAC 111 Makes Maiden Flight

New England-South Atlantic Capital's last BAC 111 two-jet transport made a successful maiden flight last Aug. 28 after a delay caused by thunderstorms and a loose propeller.

The airplane, a British United Airways machine (AW Aug. 29, p. 42), took off on a 35-min. flight to 10,000 ft. with BAC Chief Test Pilot G. R. Hicks at the controls. Gross weight at takeoff was 59,000 lb. Landing weight was 13,000 lb.

By the time the BAC 111 is 1,000 ft. for a series of maneuvers in the landing configuration. Top speed reached was 180 kt., and descent speed was 150 kt. in landing. The airplane, which is second of two BACs, will start its formal test program shortly at Vidnes-landings airport at Widley.

British Duxford, which has ordered 20 of the jet airplanes over sold, will get it into service next summer initially on the London-Glasgow route according to F. A. Lister, BUA managing director.

First flight followed a 37-month development program started by British United's sister in Vickers, Ltd. (AW May 15 1961, p. 41). First service contract was British International. Fueling for the last BAC 111 was in some manner completed at Bham.

Transatlantic Case Delay Creates Dilemma on Foreign Competition

Washington—Civil Aeronautics Board's procrastination in resolving the long-delayed Transatlantic Route Review Case has forced the Board to consider a decision regarding foreign carrier agreements in Air Dues.

Four years ago, the Board was far ahead of the game with the problem. Instead it granted temporary authority certificates for European operations to Trans World Airlines and Pan American World Airways. The Board then was eager to eliminate foreign carrier pressure by obtaining some type of agreement from the airlines. But at the time for the poor financial situation of U.S. flag carriers, some sailing this was attributed to the growing number of competing foreign airlines.

The Board continues to ask the carriers to make a decision. And at the same time, it is in a dilemma. It is in a dilemma because of a disconcerting record of attempts, but it places a greater emphasis on negotiating the routes of Pan American and TWA, in order to reduce competition and control the market. U.S. flag carriers, however, sailing this was attributed to the growing number of competing foreign airlines.

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Four weeks of hearings in the national case so far have indicated that the Board:

- Still wants capacity control over city lines, even though it feels the competitive situation is not as acute as in the past.
- Thinks nothing of use of U.S. flag carriers should be changed to provide a direct competition with British Overseas Airways Corp. from western Europe to the West Coast, and with BOMC and Qantas, on an around the world basis.
- Thinks the U.S. flag share of the

transatlantic traffic may drop next year below the current rate of 41.7%. Pan American and TWA may be unable to retain their lead factors in the face of increased competition, especially from such arrangements as Air Dues.

- Feels that a practical solution will be to divide the Pan American and TWA routes, giving Pan American a share of rights into 21 northern European countries, plus routes, without into Air Dues common and giving TWA exclusive rights to serve southern Europe and Africa. Airports, granted a share of the routes, plus TWA's routes, which serve into New York, would be terminated out of Case.

- Is less concerned than it was three years ago over foreign carriage of north Atlantic traffic. Pan American has consistently urged the Board to control some control over this traffic but when it applied the north Atlantic figures in its objections to the new concept, the Board shifted the figures to "one-offered."

Pan American's latest total objection to the proposal has concentrated most of the attention at the hearing. The airline contends that the route decisions would weaken its and TWA's ability to face the Air Dues combine, since neither carrier could rely on their operations and as presenting further markets.

Most of the two airlines would be a more practical solution, Pan American contends, since its planned continuing experience in Europe would receive strong support from TWA's domestic route network.

Most hearings are expected to run at least two more weeks before a final decision before Economic Justice Forum.

Dulles Faces Struggle to Prove Design

By Robert H. Cook

Washington-Dulles International Airport, the controversial "bathtub" trap" of airport design, faces an uphill battle of several years before its reputation can be proved conclusively either to the airline industry or the public.

A startling contrast to the finger concept adopted by virtually all other major hub airports, Dulles already is emerging as one of the most convenient terminals ever designed for the passenger.

Concept design of the 600-ft. long terminal building allows the passenger to select his ticket counter and mobile lounge departure gate with a minimum of steps, in contrast to the sprawling confusion of airports such as O'Hare.

Complaints about the distances that passengers must travel—a major source of concern at most airports—were virtually nonexistent at Dulles because of the design of the building and proximity of mobile lounge departure gates to passenger facilities and ticket counters.

Mobile Lounge Concept

In short, the designers of Dulles have eliminated the physical handicap of extensive walking distances and the psychological exposure of stress caused by substituting the mobile lounge concept for connecting finger systems between the terminal and airfield operations.

Even the problem of ground travel time between the airport and downtown Washington has been considered by the Dulles planners. Located about 17 mi. from the White House, the airport is served by 148 mi. of limited access dual highway, connecting with an excellent road system into the city.

The limited access portion now built is a part of the airport project and a second 400-ft. dual access road and system. Ground travel time for the passenger is now about 35 min. from the middle of the city but planned completion of a new connecting highway by the state of Virginia within the next few years should reduce this time to only 15 min.

However, the present traffic volume at Dulles is so great that it probably will require three more years before any accurate assessment of its capacity can be accomplished. Scheduled airline operations (now total) about 24 flights a day, or less than half that of nearby Washington (Landon) Airport, and Baltimore and less than one-third of the volume at Miami in New York.

Just as it took time for a significant shift of traffic from Willow Run to

O'Hare began operations with 432 aircraft movements per month. The figure reached 714 after six months. Midwest tracked 735 movements an month after opening in 1949. Dulles hopes operations start November with a total of 733 movements and matched 7,577 movements per month by the end of the March.

In the running argument with Baltimore over the switch of airline traffic from Friendship to Dulles, even FAA traffic experts conceded that Baltimore was being fighting to retain traffic which it has never been entitled to have.

Under FAA regulations, any airport desiring to qualify as a "large hub" city must prove that it actually handles at least 1% of the total U.S. traffic. In 1956, Friendship handled 6.41% and reached 0.96% in 1961, only after the main wing was added to land air rights there because of the ban on flight at Washington National.

Washington National

By comparison, Washington National has been handling more than 4% of the U.S. traffic since 1956. On the basis of these figures, then FAA experts contend, Friendship's claim to hold traffic does not appear valid.

Today, Dulles is a going concern—able to handle new traffic growth as it is added. All operational facilities, including three environmental canopies, the lower and upper passenger concourses, the mobile lounge, and the mobile lounge, which will be built by the airlines, but a complete new air cargo building at a cost of \$400,000. Railways, two of which are 1,500 ft. long, and 10,000 ft. long, are planned to 300,000 ft. gross loading weight, enough to accommodate the proposed passenger terminal.

Construction of a 54-million-ft. building on airport property has begun. It is scheduled for completion next year. Public parking facilities will be expanded at a cost of \$12 million next year to provide 1,700 parking spaces and also for the building of two private office buildings in the terminal area as being discussed.

FAA anticipates spending an additional \$21 million over the next few years for facility expansion of Dulles. The plan calls for at least 14 mobile lounge.

The mobile lounge, at the side but between the aircraft and the terminal building, is designed to be the key to Dulles' success or failure as the future.

For an outboard vehicle, the mobile lounge holds the dubious distinction

of being the most criticized and maligned part of equipment to enter the airport building. Dulles now uses 21 lounges. They were purchased at an average cost of \$232,000 each—a price most often singled out by opponents to the lounge concept. FAA contends that if it had used the same way buses instead, at least three would be needed per aircraft at a cost of \$55,000 each. The addition of special value equipment for ground control would make a total investment of nearly \$750,000 to serve one aircraft.

Just as new aircraft require "dog tags" to list the mobile lounge—but its problems have all been minor ones, FAA claims. Most involved maintenance to the power control system, overhauling of air conditioning units during bad weather and generator storage of transmission clutch packs. Majority of the problems were corrected on the prototype lounge under manufacturers' warranty.

Daily utilization rate on the lounge now stands at about 4 a day. The first few runs each have lagged over 2,700 mi. and the prototype 3,000 mi. or more.

The lounge is under a proposed maintenance schedule similar to an aircraft maintenance procedure, with a daily 15-min. check-up, an intermediate check at 25 mi. and a major check at 100 mi. The lounge has already passed their 100-hr. checks on a schedule which exceeds 1,000 hr. Each check check is conducted in the mobile lounge, which is a large vehicle. FAA checks around about four hours, and FAA estimates that maintenance costs are "far below" what was expected.

Lounge control panels include an indicator for each of the two engines and they are automatic on the basis of hours used rather than mileage.

Eventually FAA hopes the next purchase cost of each lounge will be less than the current price, which includes maintenance of 168 ft. of airfield, the acquisition of 63 new airports and improvements in 185 others.

These also is a hope that other future airports may adopt the mobile lounge concept and that further lower the purchase cost. FAA feels that the cost of the lounge, as necessary operational equipment, could be covered either in part or in part under the Federal Aid to Airports Act.

Initial operations of the mobile lounge first brought a flurry of queries from airlines over the difference between departure and arrival times. The airlines, however, have a longer travel time of 15 min. which it later changed to 20 min. at the preference of the airlines. Flight departure times were finally published in the departure time of the mobile lounge. Travel time

on the lounge is now around 4 min. to the aircraft, with an average of 6 min. for departure and arrival.

As traffic has increased there has been a continuing need to modify the lounge arrival and departure times to fit the needs of the individual airlines.

A study in 1958, it was added to both the arrival and departure times of the aircraft to allow for mobile lounge loading, unloading and travel time. These times are published in airline timetables and displayed on information boards.

Airline docking difficulties, caused mostly by terminal facilities, American and Eastern, for example, add only 10 min. to their schedules for the mobile lounge time.

The mobile lounge operator has also suffered some criticism from the public

Airport Aid Stresses Small Fields

Washington—Federal Aviation Agency has allocated \$75.9 million for the construction and improvement of 492 civil airports under a Fiscal 1964 budget that anticipates development of civil airports under the Federal Aviation Act and \$1.8 million for the Rock and Atlantic Coast Airport.

California has the highest number of projects—35—and the second largest total investment of \$6.9 million. San Francisco-Sacramento and Santa Ana have the largest proposed expansion projects with \$1 million each and California has the largest total investment of \$1.8 million for a new \$500 ft. runway and other projects at the Sacramento County Metropolitan Airport and \$1.2 million for general improvements to the Orange County Airport in Santa Ana.

Florida is third in the allocation rank with 28 proposed projects requiring \$5.6 million in federal aid. The two largest sums involved in \$2 million for expansion of the airport at the new Jacksonville Municipal Airport and \$1.5 million for land purchase and construction of two 4,000 ft. long landing strips at the Maitland County General Airport in De Leon County.

Other states with large allocations are Texas, which has allocated \$5.5 million to aid programs, with the largest amount of \$5.7 million charged to the Houston airport. Majority of the Houston total will be spent for land acquisition needed for airport development and approaches to new runways.

Georgia, primarily because of proposed expansion of the Atlanta Municipal Airport, has the second largest allocation with \$4 million. Pending final approval by the FAA, Atlanta would claim \$3.5 million of the sum for runway extension and a new 5,000 ft. long runway to parallel its existing Runway 8-23.

New York claimed the greatest sum among the states, with a total of \$16.1 million allocated for 13 projects. Largest



- 1 The Spey powered BAC One-Eleven has been ordered by 7 airlines in 5 countries.
- 2 The Spey has completed more than 12,000 hours development running including over 4,000 hours in the Hawker Siddeley Trident.
- 3 Flight testing of the Spey powered Hawker Siddeley Buccaneer S-2 strike aircraft is now proceeding.
- 4 Spey powered Tridents are being delivered to British European Airways this year.

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	Revenue Miles 2001	En Pass Miles 2001	En Pass Miles 2000	Average		Fuel L/P (%)	YTD Miles 2001		Avg. Fuel Consumption 2001	YTD Miles 2000	Avg. Fuel Consumption 2000
				Fuel Landed	Fuel Burned		Revenue	Avg.			
DOMESTIC FLIGHTS											
Airbus	83,407	8,245,108	8,257,709	51.9	51.8	81	83,410	832.821	830	832.1	831
Boeing 737	13,216	1,811,712	1,816,223	38.3	37.9	31	13,216	181.171	13,216	181.2	13,216
Boeing 747	13,007	2,841,063	2,841,063	89.8	89.8	89	13,007	284.106	13,007	284.1	13,007
Boeing 767	30,169	1,861,840	1,861,840	61.8	61.8	61	100,770	232.316	830	232.4	831
Boeing 777	30,309	2,933,406	2,933,406	97.4	97.4	97	293,341	974.807	293	974.8	293
Boeing 787	12,372	833,476	833,476	67.5	67.5	67	12,372	83.348	12,372	83.3	12,372
Boeing 797	9,116	269,344	269,344	29.3	29.3	29	40,279	44.240	63	44.2	63
Boeing 800	17,193	1,000,000	1,000,000	58.2	58.2	58	11,048	121.728	830	121.7	831
Boeing 810	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 820	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 830	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 840	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 850	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 860	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 870	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 880	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 890	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 900	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 910	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 920	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 930	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 940	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 950	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 960	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 970	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 980	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 990	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1000	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1010	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1020	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1030	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1040	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1050	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1060	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1070	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1080	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1090	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1100	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1110	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1120	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1130	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1140	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1150	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1160	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1170	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1180	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1190	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1200	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1210	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1220	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1230	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1240	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1250	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1260	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1270	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1280	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1290	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1300	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1310	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1320	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1330	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1340	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1350	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1360	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1370	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1380	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1390	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1400	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1410	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1420	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1430	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1440	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1450	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1460	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1470	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1480	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1490	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1500	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1510	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1520	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1530	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1540	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1550	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1560	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1570	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1580	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1590	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1600	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1610	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1620	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1630	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1640	10,000	2,400,000	2,400,000	240.0	240.0	240	14,257	144.440	830	144.4	831
Boeing 1650	10,000	2,400,000	2,400,000</								

AMOUNT	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991	2992	2993	2994	2995	2996	2997	2998	2999	3000
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AGENCY SERVICE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	29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KINGS & NEWBORN												
Shades Adults	610	2,535	7,202	13	13	5	2,516	9,013	1,72	65	2	
Shades Newborn	730	1,310	7,430	1	1	1	784	1,310	1,310	1,310	1,310	1,310
Adults	1,640	38,173	40,549	25	1	40	3	1,414	3,333	2,36	51	1
Shades	916	1	1	1	1	1	1	1	1	1	1	1
Newborn	1,397	35,832	40,479	30	40	54	8,117	7,280	2,33	23	1	1
Shades	1	1	1	1	1	1	1	1	1	1	1	1
Shades (Combined)	704	3,460	11,447	27	14	32	1,128	1,163	1	41	34	4
Shades	400	40,716	44,444	1	1	1	1,547	1,547	1,547	1,547	1,547	1,547
Newborn Adult	1,610	1,267	17,358	19	49	31	1,104	1,104	1,104	1,104	1,104	1,104
Shades	122	169	276	1	3	3	28	28	28	28	28	28
Newborn	1,630	4,710	18,479	1	1	1	1,544	1,544	1,544	1,544	1,544	1,544
Kings & Newborn Total												
	6,642	184,621	407,130	11	47	2	24,296	25,420	2,420	44	2	

HELICOPTERS									
CHRYSLER	517	370	6,370	7.9	30.2	20	0	120	0.25
less supplies	287	3,684	6,370	7.9	32.8	41	120	0.82	46.4
New York	888	3,450	5,550	11.0	18.9	44	140	2.12	44.7
Helicopter Total	222	0,120	12,950	7.9	18.9	40	680	3,400	0.8

Cargo & Other		Cargo & Other		Cargo & Other		Cargo & Other	
Aviation	161	400	1,180	83	117	70	81
Flight Team	3,999						119
Hotel	1,130						59,516
Ground	2,028						32,072
Stk	993						27,009
							9,894
							18,378
Cargo & Other Total	4,476	601	3,160	70	147	148,761	129,753

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U. S. Airline Scheduled Service Traffic Growth First Six Months 1963 over 1962

Geographic Areas	Percent Percentage Miles (200)				Mileage Land Policy (%)				Revenue Per Acre (200)			
	1980		1982		1980		1982		1980		1982	
	Revenue	% Increase	Revenue	% Increase	Revenue	% Increase	Revenue	% Increase	Revenue	% Increase	Revenue	% Increase
Alaska	1,176,154	2,758,100	177,847	50	14	371	241,375	453,400	18,000	4	0	
North	501,457	555,453	53,996	10	22	101	14,070	15,769	4,500	7	0	
Central	447,152	526,100	78,948	17	10	10	10,000	10,000	10,000	10,000	10,000	
South	227,545	1,726,547	207,544	40	44	1	544,700	73,600	73,600	73,600	73,600	
Western	2,502,075	7,733,450	5,237,071	75	50	10	136,671	202,201	13,000	10	0	
Alaska	174,476	344,476	169,999	44	44	1	10,119	10,119	10,119	10,119	10,119	
North	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
Central	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
South	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
Western	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
Alaska	1,176,154	2,758,100	177,847	50	14	371	241,375	453,400	18,000	4	0	
North	501,457	555,453	53,996	10	22	101	14,070	15,769	4,500	7	0	
Central	447,152	526,100	78,948	17	10	10	10,000	10,000	10,000	10,000	10,000	
South	227,545	1,726,547	207,544	40	44	1	544,700	73,600	73,600	73,600	73,600	
Western	2,502,075	7,733,450	5,237,071	75	50	10	136,671	202,201	13,000	10	0	
Alaska	174,476	344,476	169,999	44	44	1	10,119	10,119	10,119	10,119	10,119	
North	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
Central	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
South	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	
Western	708,303	7,733,450	7,025,147	44	44	1	10,119	10,119	10,119	10,119	10,119	

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Heliports		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987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Chicago	1,840	2,112	1,049	26	11	3	112	20	1,010	194	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

CASH & OTHERS										
Balance 1							1,144	1,367	0.9	10.8
Deprec	1,206	111	(278)	48	70	77	12	83	11.0	20.9
Net							10,409	12,863	104	1.9
Net							4,407	11,770	P 134	1.08
Net							19,774	17,237	A,205	12.1
Net								8,334	8,334	
Net	1,206	111	(278)	48	70	77	16,900	17,134	10,540	100

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What would it take to divert the X-15?

One that can't even be seen with the naked eye could throw the X-15 way off the beam, from line of its soaring flight. Let these minuscule particles batter in one of the extremely low tolerance reflector tubes of the hydroscopically operated light control system—and things begin to happen! The trouble is, this would be hazardous at an extremely 4000-mph speed that generates the slightest particle control slightest to enormous extent at actual flight path.

This problem of minuscule hydroscopic grains partly was solved in the early days of the X-15's development by installing two specially designed Purulotor filters. Of compact design in wench-acting aluminum, these filters remove 100% of all particles 10-microns or larger. The elements are of thermal shock-resistant stainless steel wire cloth—capable of functioning effectively through a -80°F to +100°F temperature range.

Purulotor's sensitive design and development of the X-15's high pressure hydraulic filters to put one of its many contributions to aerospace progress. Purulotor filters have helped solve filter problems for virtually every type of airborne and ground support equipment produced by the aerospace industry. For more information in terms of your filtration needs, write today. No obligation... and we'll send you a copy of Purulotor's new quarterly publication "Aerospace Filtration". It's packed with features and articles of particular interest to companies active in the aerospace industry.

Write to Purulotor Products, Inc., Rahway, N.J.



Filters For Every Need Plus
PURULOTOR
Purulotor, Inc.
Rahway, New Jersey 07065

This is Purulotor's Filter Q 412 S. Dapco fine capacity, about 350% long. It has a monomedia, fine type meshwork of stainless steel wire cloth. It provides 100% filtration of particles 10 microns and larger and 99% filtration of all contaminants as fine as 10 microns. Designed for 3000 psi operating pressure, it has a maximum differential pressure of 40 psi and is rated with isolated rated value.



Airline Income and Expenses—May 1963

(In Thousands of Dollars)	OPERATING REVENUES					Total Operating Expenses	Net Profit (or Loss)	
	Passenger	Cargo	Other Non-Mail	U.S. R. Mail	Federal Subsidy			
DOMESTIC TRUNKS								
American	21,714	2,115	31	191		24,051	26,722	2,671
Boeing	6,496	457	138	187		7,278	8,949	1,671
Continental	2,640	59	58	133		2,990	3,744	754
Delta	18,172	5,049	179	325		24,325	14,499	9,826
Eastern	31,164	1,281	199	473		33,117	26,948	6,169
Northwest	2,161	457	49	136		2,803	3,007	204
Southwest	3,420	119	95	36		3,660	4,103	443
Northwest	7,124	832	32	341		8,329	8,347	19
Trans World	24,799	1,211	335	684		27,029	27,423	404
United	44,123	3,092	156	1,967		49,338	46,638	2,700
Western	4,284	268	110	189		4,851	5,339	488
Domestic Trunk Total	197,706	12,113	1,483	4,760		216,062	189,373	(1,667)
INTERNATIONAL								
American	471	39	17	41		568	1,187	619
Boeing	403	29	4	72		458	476	29
Delta	194	25		1		220	237	17
Eastern	2,671	165	1	48		2,885	2,854	31
Northwest	187	8	10	19		224	199	25
Southwest	1,604	448	216	627		2,905	3,124	219
Trans World	1,191	353	119	132		1,795	1,778	17
United	32,323	6,359	5,847	9,790		45,409	41,473	3,936
South Pacific	34	1		1		36	99	63
Trans Continental	501	56	331	1		889	877	12
Trans World	8,126	846	343	1,761		10,076	9,436	640
United	2,163	72	23	107		2,363	1,446	917
Western	389	16	7	5		417	442	25
International Total	51,761	8,714	6,377	9,341		76,193	68,776	7,417
LOCAL SERVICE								
American	768	38	15	4		825	1,191	366
Boeing	489	54	7	18		568	584	72
Continental	798	54	39	32		923	1,276	647
Delta	267	26	9	15		317	314	3
Eastern	1,493	76	43	36		1,648	1,591	57
Northwest	1,443	93	37	67		1,640	1,188	452
Southwest	615	49	4	99		767	1,129	362
Trans Continental	1,219	40	36	37		1,332	1,081	251
United	744	42	58	27		871	1,076	185
Western	235	47	8	17		267	1,044	777
West Coast	375	31	13	10		429	1,337	908
Local Service Total	13,948	474	219	310		15,051	16,774	1,723
ALASKA & HAWAIIAN								
American	217	60	29	73		379	741	362
Boeing	131	34	40	17		222	263	61
Delta	319	7	4	5		335	461	126
Eastern	798	54	39	32		923	1,276	647
Northwest	267	26	9	15		317	314	3
Southwest	1,493	76	43	36		1,648	1,591	57
Trans Continental	1,219	40	36	37		1,332	1,081	251
United	744	42	58	27		871	1,076	185
Western	235	47	8	17		267	1,044	777
West Alaska	113	42	178	100		363	549	187
Alaska & Hawaiian Total	3,148	336	264	363		4,111	4,886	1,091
HELICOPTERS								
Chicago	19	16	1	2		38	129	91
San Antonio	20	16	1	2		39	129	91
New York	20	16	1	2		39	129	91
Helicopter Total	59	48	3	4		114	387	273
CARGO & OTHER								
American								
Boeing								
Continental								
Delta								
Eastern								
Northwest								
Southwest								
Trans World								
United								
Western								
Cargo & Other Total	3,686	6,448	413	413		10,960	8,561	2,399
Infantry Total	246,076	21,407	18,118	19,899	6,387	282,266	267,423	14,843

Revised May & Rev

DOUGLAS DC-8F GIVES



AIR CARGO ITS BIGGEST LIFT!

A new performance record for the books has been credited to a new DC-8F jet freighter, recently delivered to Trans-International Airlines.

In its first eight days of contract operations by T.I.A. for the Military Air Transport Service, the big Douglas cargo-jet delivered a total of 234,637 pounds of freight to Southeast Asia from California. Distance logged on the three round trips was more than 50,000 miles.

On one of these trips it airlifted the heaviest payload ever carried operationally by any transport—87,028 pounds—from Travis Air Force Base near San Francisco 8900 miles across the Pacific to Saigon, South Vietnam. Stops were made at Honolulu and Guam.

This record-breaking jet freighter has a ferry range of more than 7,000 miles and a cruising speed above 575 mph.

In addition to T.I.A., other airlines which have DC-8Fs in operation or on order include Capitol Airways, KLM Royal Dutch Air Lines, Trans-Canada Air Lines, Trans Caribbean Airways, and United Air Lines.



DOUGLAS BUILDS GREAT TRANSPORTS

AIRLINE OBSERVER

► U.S. domestic airlines have reported a net profit of \$3,594,000 for the first six months of 1963 (Aug. 13, p. 47), compared with a net loss of \$7,322,000 in the same 1962 period. Industry total net earnings for June reached \$18.6 million, more than double the net gain of \$7.4 million in June last year. First-half operating revenues for the 11 trunk air carriers totaled \$1.194 billion and operating expenses were \$1.135 billion. For the same period in 1962, operating revenues were \$1.124 billion and operating expenses were \$1.182 billion.

► New drive to expand competition on the relatively new southern transcontinental route (AW May 6, p. 42) has been launched. Continental Airlines has made a bid to the Civil Aeronautics Board to extend its present routes into Georgia and Florida, which would give the carrier a route from the West Coast to Miami and Atlanta. American Airlines also seeks a Miami-Dallas route with an east-bound operating one-stop, coast-to-coast service on the route. Similar bids from other carriers can be expected as a result of an invitation by the Board calling for suggestions on the scope of change in the case which was forwarded to the Board by the Court of Appeals last year.

► Aluminum Co. of America (Alcoa), not wishing to relinquish any ground in the steel industry, has initiated a publicity campaign boosting development of a Mach 2 supersonic transport rather than a Mach 3. Alcoa says that a Mach 3 aircraft could be built at less public cost, could be available sooner and would be more economical for U.S. domestic routes.

► Red China added to its growing feud with Russia by giving wide publicity to the crash of an Aeroflot Tupolev Tu-954 that tried to land at Hainan Airport last month. Soviet press totally ignored the accident, which killed the Albanian ambassador to China, six other Albanians and three Chinese. Remains of the Albanian and Chinese victims were brought to Peking for a big public burial, attended by Premier Chou En-lai and other top Red Chinese officials.

► De Havilland Aircraft Co. is considering the production of a group of Coast Guard transporters as replacements. Manufacturers already began production of five Comets without orders and since has sold three—two to Kuwait Airways and two to United Arab Airlines. Negotiations for the other two are under way with Middle East Airlines and Royal Air Force.

► Equity financing—either through debentures or new stock issues—is among methods of financing being considered by Trans World Airlines to pay for additional Boeing 747 transports. Orders for 10-14 aircraft of similar type was expected to be announced over the weekend. TWA board of directors met Thursday and Friday in Seattle.

► British Overseas Airways Corp., encouraged by increases in load factors on the North Atlantic, now feels it has a chance of breaking even in the current fiscal year after several years of reporting heavy losses.

► Island Airlines, an upstart low-line, day-as-needed carrier in Hawaii (AW June 10, p. 49), has been virtually grounded by a federal court ruling which grants a Civil Aeronautics Board request for a permanent injunction against the carrier. Decision placed the airline's operations under federal protection on grounds that operations between the island were conducted over international waters. Island Airlines had held that its flights were interstate and, therefore, outside the protection of the CAB.

► Russian Aeroflot has inaugurated regular weekly flights to Brasilia, capital of the Republic of Mato Grosso, by Boeing 747s that fly from Brasilia on Aeroflot's established West African route from Rabat, Morocco, to Casablanca, Conakry, and Accra, Ghana. Brasilia is the first national capital served by Aeroflot.

SHORTLINES

► Austrian Airlines plans to introduce Vickers Viscount turboprop transport service between Innsbruck and Garmisch-Partenkirchen, a two-weekly basis during the 1963-64 winter season. During the same period, the airline plans to extend its schedules between Vienna and Athens, providing service to Tel Aviv.

► Swissair Air Lines reported net earnings for the first six months of 1963 of \$450,118, compared to \$123,381 in the same period last year. Total operating revenues for the first half rose 16% to reach \$6.2 million.

► Kuwait Airways will extend its Middle East route from Bombay, Karachi and Kuwait into Europe, with London as a terminal point. A de Havilland Comet 4C transport will be used on the route.

► National Air Carriers Assn. now represents 12 of the 15 existing supplemental airlines, either through its trade association activities, its parent-owned division or both. Three new members that bring membership to a total of 12 are AARCO Airlines, Stranded Airways and Trans International Airlines.

► Scandinavian Airlines System will introduce new low-line, economy class passenger flights between the U.S. and Scandinavia on Oct. 17, using Boeing Douglas DC7C aircraft. Round trip fares on the flights will be \$450.20, a reduction of \$147.35 from normal economy class fares.

► TWA Airlines will expand its Detroit-Cleveland commuter service to include weekends to supplement the week-day schedule of 11 daily round trips between the two points. Initial flights will include two round trips on both Saturdays and Sundays.

► Trans World Airlines has reported a 25% increase in domestic revenue passenger miles for July over the same month last year. International traffic climbed 11.7% in the same comparative period and total revenue-mile traffic increased 29.5%.

► United Air Lines will expand its One-Class Service schedules Sept. 9 by adding 18 new cities to the 8 already covering the service. Number of One-Class Service flights will be increased from 35 to 71 daily. According to United, the flights—including overnight flights which are operated primarily by cargo—have had a 63.5% load factor, compared with a system load factor of 54.5%.



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Coxs and GD F-121A/B Project Engineer W. C. Davis

Subcontract management philosophy provides for basic technical qualifications and timing requirements to be established at Ft. Worth, with all configuration management here and subcontract authority, in one place here.

Most of the major infrastructure projects have been let, although in some cases definitive contracts have not yet been awarded in order to speed the program. Among major subprojects to be allocated are the variable wage, unemployment and social insurance subproject. The latter probably will acquire three subcontracts. These are expected to be let soon. With major investments out, next round of contracts probably will cover parts fabrication, including such things as pipe stringing. Some long-lead time material contracts have already been let.

Total Subcontractor

Industry sources are that the program will involve about 4,000-5,000 subcontractors of a varied nature, including machining. When tested and following her sales are considered, the total will probably be about 20,000 subcontractors. Major subcontractors for Grumman are estimated at approximately 50. Those for McDonnell, which is handling the new engine system, will probably number some 45-50, with their own subcontractors branching out from there.

Changamp authority for purchasing comes from the GD-FW F311A, material department, working from a detailed list of items specified for these airplanes and allocating responsibility for common store stock—such as aircraft items and engine—would be handled for the department by the GD-FW Ds, material department.

Programme chief under F-111A/B military department R. Kates, says you, a half dozen purchasing agents who select, negotiate and administer contracts. An in-plant subcontract management coordinator manages and direct, monitor and advise and inspect the subcontractor.

Subcontract selection procedures shown in scope and thoroughly reviewed here previously, with lists of candidates reviewed by Cosby and approved made by Davis. Similar procedures followed in selection with final GPC approval. The GPC was represented by the "E-111A/B USA" American People Office in the American subcommittee, for example, some 400 calls were listed originally as potential suppliers and initial screening at GPC/PW reduced this to 221. The driving's performance committee approved 177 calls for review, resulting for approval 163 (RFPs) and 14 rejected and 106 of these turned out to be on contracts for about a dozen contracts.

Structural component subcontracting probably will not develop significantly.

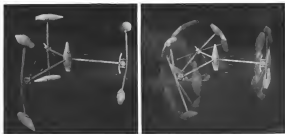
for resident officers as extensively as in the case for subordinates, because CD personnel indicate, the confidence level is higher between superior-subordinate than between superior and subordinate peers, particularly across

Have rule been an oversteering rule/
break-out of work to a further rule level
is that GDI/TW must approve all con-
structs if they are critical in terms of
engineering, time or dollars

Subsystem: Stream

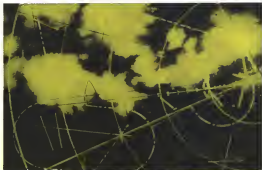
Private enterprises and their structures are modern, but not beyond the state of the art, supporting economic development to meet basic and not excessive and also in order to provide a high level of competitiveness and quality of life. National development is not an abstract act as a specific response to the needs of the population, the schools and not in the State for its concrete purposes. If the contractor doesn't get the relatively considerable incentive portion, he doesn't get any of the other incentives, CDD/T get the prime contractor will wage competition for economic recovery.

In order to boost reliability and maintainability, a comprehensive analysis review technique, which includes a computer network, is used to keep track of this area. Further, GSD has devised a parts control and standardization procedure for subs, which requires that they each act up a specific parts store.



Gyroscopic Space Station Design Being Studied

[illegible]



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- solicitation team to confer periodically with CIO/FW

Purpose is to develop listings of all parts to be altered in assembly, or electro-mechanical equipment, then develop the lists to ensure the use of proper parts and also to diagnose in many of the common parts for as much equipment as possible, by developing rollouts lists. This procedure is also expected to reduce spare stocking requirements. Every subsystem will be given a sub-baby "buggy" figure that the sub has to work to meet.

PERT/Cont Use

A prime management tool for contractor and Air Force use to keep track of the program will be the new version of Performance Evaluation and Review Technique (PERT), which adds cost data. New PERT/Cost is a marriage of time scheduling with dollars and is designed to show prime and Air Force program managers how the money is being spent and whether costs are over or under budget in relation to the schedule.

T112B-ED program is considered a threshold for PERV. Cost, along with the very mobile medium-range ballistic missile, and a part of GD/PW's continuing obligations. Considerable study has been made in an attempt to define the view aspects that will be met and to what extent. For example, an earlier consideration had been to provide data on items down to the level of those having a total cost of \$150,000 in three-monthly periods, but this has been discarded after analysis indicated that this would mean keeping detailed track of about 40,000 items.

Case Data Reported

On FIAA's PERC/Cont will as part cost data regularly on about 70 items routinely. This can be extended to possibly 100 items, although if done well the system could be expanded to take in approximately 1,600. The core monthly report giving data on cost budget, actual costs and estimated future costs, related to time schedules goes to prime contractor management, subcontractors on economic contracts and cognate agencies. The latter include Systems Project Office, training center, Medical Air Command, Naval Air Station, Navy, Bureau Weapons and Naval Air Development Center.

Certain subcontractors, such as Pratt & Whitney Aircraft and Hughes, will report PERT time data to CDD, but reported cost data will funnel to the E-11A/B SPO as Automated Systems Inc., as in normal operations data.

System stores on IBM 7090 to handle PERT trac, an IBM 7090 to do cost. In essence, the F11A/B is broken down into various components

and systems, rolled and then subdivided. Specific items, or components, such as the nose landing gear, are then cross-referenced with the functional elements of the organization needed to convert them into finished products, such as engineering, tooling, fabrication and assembly.

Work packages are made up of doing these tasks on every item and the package is then networked for computer use to display costs and activities. The work package also is associated with activities in other tasks to which it is related. Cost accounting techniques were first established at GID/FTI. The company's early customer data were generated from the production line, for example, in form acceptable by the computer. The computer takes the accumulated costs and distributes them accordingly into work numbers, which are then recorded in summary numbers. The summary numbers, in turn, can be provided the basis for performance-based performance estimates.

Adapted from *Journal of Management Education*, 2000, 24(1), 10-18. Copyright 2000 by Sage Publications.

Program management network currently has about 2,000 members as listed. They will at least triple that number by the end of the year, as the network grows as the subcontractor network is added. Features of the network, including its broad-based membership, are listed below. Features of the network that are not reported, rather than critical path problems, include: software architecture, project management, GID/PW below, in the small FIRM/PA development program, because of the device and options toward completion and right of the initial flight articles, rather than being primarily concerned at this time with the overall program, such as future production.

Acrospace Companies Report on Salaries

Washington—Following is a list of aerospace industry directors and officers with 1962 salaries above \$75,000, and their stockholdings, as they were reported to the SEC.

[illegible]

Charles Wright Cow—T. B. Barnes, chairman, president and director (part-time salary); with shares of common stock: J. B.



Colossus.

This is an aircraft bearing gear for a HAWKE roller antenna.

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LOCKHEED-CALIFORNIA CO. employs experts in its automatic data acquisition center (left) at Lockheed space beginning new assignment. Job data is fed into the system through the RCA-built input unit by means of a punch card as the dot in the left. Operator at Lockheed Martin & Space Co. (right) directs as system in the central runway unit of ADA system, where production work administration is maintained. Data processor locates answer in data base file and send answer on printer as about 7 sec.

Data System Used in Production Control

By Harold D. Watkins

San Jose, Calif.—Data acquisition and retrieval system that its developers say may become "as standard as tape or telephone" is assuming a major role in production control at Lockheed Martin & Space Co. here.

The feature concerning the new management tool was made by Herschel J. Rosen, executive vice president of Lockheed Martin & Space, the Lockheed Aircraft Corp. division where Lockheed has pushed its development to the greatest extent. Data acquisition heart of the system is known as ADA for automatic data acquisition. With its associated data processing center and its query and read out equipment, ADA is part of Lockheed Martin's overall management information and control system, and is considered a major cost cutting device.

Feeds Data

Using ADA and other tools of the system, Lockheed executives can obtain continuously updated information concerning the location and status of any of the 55,000 active shop orders and related parts as they move through the manufacturing cycle for 700 new models, Agma space vehicles and other defense products.

Additional work for ADA are being planned in rapid. According to present plans the data acquisition system will be collecting information concerning some three dozen areas of activity

by mid 1964 when ADA is scheduled to move out of development stage to fully operational status at Lockheed.

Lockheed specialists have been working on the ADA concept since about 1958. They were joined in 1960 by Radio Corp. of America which developed prototype equipment for remote transfer of information. First units of the prototypes were installed at San Jose in August, 1961, where they were first used for recording the receipt of materials at receiving docks and subsequent movement to inspection and storage. The first step in shop-order location control began in March, 1962, with installation of 38 RCA-built remote report stations in one factory building. The second phase began last December when the central electronic data processing equipment and the remote query and report units were added.

Impact of the complete system at Lockheed is demonstrated by elimination of some 700 jobs, including most of the jobs of 600 employees who had toured locations at parts in process. Production control reporting and check-out operations also have been simplified, and ADA system experts are forecasting a net annual savings rate of \$2.8 million in directly identifiable personnel and machine process costs by June of next year. Other savings due to general increase in efficiency and in reduction of parts tossed into scrap are expected to be considerable.

Essentially a communications system, ADA and its associated equipment com-

ponents either then replaces the existing data processing equipment at Lockheed Martin & Space. The distinguishing characteristic of the ADA complex there is its ability to enable those at remote locations to compare each add data be fed as it is entered, and to retrieve it on demand. Most data processing is done in batches, with information collected until there is a sufficient amount to permit efficient computer operation. ADA's continuous processing—called online operation—distinguishes the Lockheed system from most other current efforts to adopt electronic data processing to production control, those working with the ADA system alone.

Other Facilities

While the management information system has reached its fullest development at Lockheed's Martin & Space Div., the acquisition is also phasing in at Lockheed-California Co. and Lockheed-Gallop Co. All three share the basic RCA Edge electronic data gathering equipment remote information report networks to send information to a central processing point. Lockheed Martin now has nearly 200 of those units, Lockheed-California about 150 and Lockheed-Gallop 50. By the end of 1964, Lockheed Martin will have a total of 715 report machines installed. Lockheed-California also will have 275, and Lockheed-Gallop 200.

Lockheed Martin is the only division where full-scale operation has been reached. At the other two divi-



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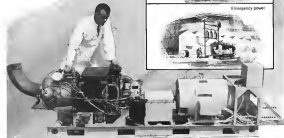
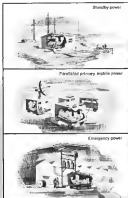
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into the increasing data collected on paper tape from which it is transferred several times a day to computers (large for response to inquiries and for other use in an off-line operation. Lockheed-California is using ADA data for proof-of-concept, in addition to shop order control and later distribution accounting. Lockheed-California presently is using ADA primarily to control building production flow. The central data processing equipment and support units used by these two divisions differ from those employed at Martin & Space Div. at Lockheed experiments with various units. All ADA equipment is local.

On-Line Operation

In the on-line operation at Lockheed Martin, approximately 150 mobile input stations are located in a total of 11 production buildings in Sunnyvale, and close to 10 more are in the division's two Van Nuys plants, some 50 miles to the south. Basic input information is transmitted by means of punched cards and personnel identification tokens which are read in slots in the Edge input unit. Even on the front of the console indicate type of transactions being made and permit retrieval of additional information, when called for.

Input transactions are transmitted through ordinary telephone lines that connect the system to the data processing center here where two RCA 501 data processors direct the processing message flow, record data and extract answers to inquiries. An RCA 506 data disc file capable of storing 55 million characters in the integrated information storehouse.

At present about 4,200 production workers in Sunnyvale and 580 in Van Nuys are tied into the ADA system. These 5,000 represent most of the production workers among the division's total employment of about 33,000. Those reporting to ADA start their day by checking in on a credit card which data which can only be read magnetically. They then check in again to ADA on the input console nearest their work station by inserting magnetized identification tabs.

If this is completing a job begins either they continue their work on the ADA console. If they have no assignment when this input for work, they have 30 sec to receive a shop order from their supervisor.

Shop orders, which are instructions to perform certain operations on a part or parts, are initiated in the production control department. There, job pack, ages including the shop order, drawings and subassembly are prepared along with a special ADA shop order control punch card which establishes a number for each order. This number with instructions and schedule and associated



COMPUTER STAFF MEMBER creates RCA 506 data disc file at Lockheed Martin & Space data processing center in Sunnyvale, Calif. The 24 discs rotate at 1,200 rpm, and are coated on both sides to provide 45 million characters. User can magnetically store up to 48 million characters of data, secured from remote stations. Data is fed back to input stations upon demand.

ated part numbers are also recorded on the data file. The job package and part or parts then begin their flow through the manufacturing cycle with delivery to a final station where work distribution to various shops is controlled. Dispatching at these final centers (in a sense) is shop order to ADA, and the job package then goes to a supervisor who assigns the shop order to an operator. This employee, in turn, reports to ADA on the nearest Edge unit using the shop order control punch card and his identification tab. The report console automatically adds a number identifying the station, and the control data processing machine appends the date and time to the message. This information flows through the RCA 501 to the data file where it updates the pertinent data.

Job Completion

Completion of a job is reported to ADA by the supervisor who also indicates with keys where the shop order is going next. The worker reports the start of work on a new shop order. On leaving for the day, the employee checks out both to ADA and the input tape clock.

Stand information regarding location of shop order and part is immediately available through use of RCA Edge automatic inquiry and reply stations. These are presently in use at three in Sunnyvale and one in the Van Nuys facility, and they are generally located in production control offices. A total of 25 inquiry

stations is planned. Question about status of a particular shop order, for example, is initiated by dialing the proper identification number on a dial containing 25 wheels.

Upon receipt of this inquiry at ADA processing center, the message is scanned by one of the RCA 501s which then sends it on to the second 501. This in turn responds by reading out the desired data from the data file storage. The answer is printed out at the inquiry point by a printer adjacent to the display unit which repeats out the information.

Time Interval

Time from initiation of inquiry to completion of printing of a machine report is about 7 sec.

In addition to printing the status number where the shop order was last reported, ADA also indicates the day the shop order was scheduled to be started and completed. Inquiries can be coded so that the data processor will respond with a complete manufacturing history of a shop order up to that time. Location of all units of a particular part throughout the manufacturing cycle can also be obtained.

Availability of continuously updated information concerning shop order and part location is proving of significant value to Lockheed Martin & Space, according to Norman J. Breen, director of systems planning for the corporation. "It enables us to monitor immediate shop order status better by reporting in-

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positioning and moving parts shortages. One of the greatest benefits is that as each existing engineering changes either "fix" the problem that has been able to locate all parts affected by such a change almost immediately has resulted in a significant reduction in the number of parts that are tossed into salvage because they are processed with outdated instructions.

A low element of the design's ADA system is the magnetic tape journal which records all incoming transactions, averaging about 25,000 daily. This journal serves as a back-up to the disc file, and data is printed out approximately every two hours to provide a check on improper or incorrect transactions. Journal data is also used for important off-line data processing such as changing shop orders against the work order accounts established for contract billing.

System Shutdown

While ADA is now operating without significant problems, the Lockheed Martin & Space Co. operations broke down completely during the phase-in period last year. After the first installation of 35 remote read stations in March, connectors of bus to 18 were added to the bus (with the total reaching 65) around the first of the following July. At that point, as a consequence of problems, including a major fire in the switching mechanism for routing messages, resulted in the breakdown. The system was shut down throughout July while the problems were analyzed and modifications were made to overcome them.

Next operations to be placed online in the ADA system will be data control of the approximately 100,000 pneumatic orders placed by the division monthly. Implementation is planned for this month at Van Nuys and by September in Sunnyvale. ADA systems will keep track of what is on order, how much has been received and the location is the plant of the material as it moves from moving dock to inspection and shipment.

Optimistic View

Optimistic outlook is that by September of 1964—three months after ADA is immediately installed—the accrued identifiable savings will have, off of the \$2,250,000 which will have been spent up to that time on the data acquisition and repair costs, according to G. S. Deane, who heads the Lockheed Martin & Space group responsible for ADA.

With hardware problems largely out of the way, emphasis is now on refinement and further development of system programming. Additional applications scheduled for other on- or off-line operations include customer information analysis, inventory control,

vendors' price history records, and suppliers' product performance ratings. Also being considered are such functions as forecasting future manpower and facility requirements.

ADA reports as they are just beginning to convert potential users of this data gathering system. Deane can forecast that the program could evolve to the point where the ADA complex will take care of all operations, thereby eliminating a great deal of record status reports. "For example, it would print out only reports of inventory items that were low," he explains.

Within the next 18 months, ADA will be introduced to Lockheed Electronics Co., New Jersey and California, and Lockheed Aircraft Service Co., New York and California. A total of about 100 ADA report assemblies are scheduled to be placed in operation in those two divisions by the end of 1964. No schedule has yet been established for the use of ADA at units outside Lockheed Martin & Space Co.

Among other aerospace industry applications of remote data acquisition and control is use at the Boeing Aerospace Div., Seattle, and North American Aviation's Rockwell Div., Torrance.



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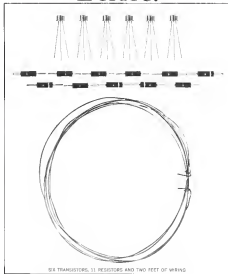
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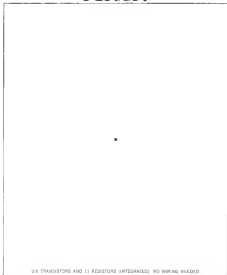
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San Marco Satellite to Probe Air Density

By Warren C. Wetason

Rome—Project San Marco, involving the first satellite designed and built in Western Europe, is the fruit of extensive collaboration between Italy's National Research Council (CNR) and the U. S. National Aeronautics and Space Administration.

Project will undertake the hitherto unattempted continuous measurement of air density by an experiment on board the satellite which will be launched by a Scout booster into a near equatorial orbit from a mobile, Texas-type launch platform in the Indian Ocean (AW Aug 12, p. 64).

Under the agreement signed last Sept. 5 by Vice President Lyndon B. Johnson and Italian Foreign Minister Pietro Securi, NASA is supplying Scout and Shopet launch vehicles—the latter for use in suborbital tests—and the use of its facilities. There will be an exchange of techs.

In addition, a number of Italian engineers have received on-the-job training in launching techniques and procedures, radar acquisition and satellite assembly and mating at Goddard Space Flight Center. Training periods lasted up to nine months.

"We are very much indebted to Goddard," Prof. Luigi Braglia recently told

Aviation Week & Space Technology. Prof. Braglia is chairman of the CNR's Space Research Commission and head of the University of Rome's School of Aerospace Engineering and Aerospace Research Center (CIRA). The latter organization has our responsibility for Project San Marco.

Preliminary design for the San Marco satellite were begun in May 1961, and completed an airtight letter Detail design was finished in June, 1962, and, after the signing of the Sept. 5 agreement, construction of the satellite commenced in the CIRA facilities at Ubric Airport near Rome.

First prototype was produced in about 40 days and testing began at Goddard the first week in November. Braglia, who emphasized that everything except the small electronics components was built in the Ubric laboratory, believes this to be a critical time for satellite fabrication.

Four prototype San Marco satellites were built in six months, of which two underwent tests in simulation at Goddard.

Program has been broken down into four phases, the first of which has been completed.

•Phase One—Suborbital shot from Wallops Island with a Shopet vehicle took place April 23. Third prototype

satellite was used for this test, which was rated only partially successful due to a malfunction of the booster drop motor. Second attempt on Aug. 2, using the fourth prototype, was successful.

•Phase Two—A suborbital test from the launching platform is scheduled for the end of this year, again employing the Shopet booster.

•Phase Three—At least two San Marco satellites will be orbited from Wallops Island by Scout booster during the first quarter of 1964.

•Phase Four—Operational Scout orbital launch from the platform is slated for late 1964 or early 1965. Prof. Braglia said that one satellite should provide the desired amount of data, but a backup will be provided for any contingencies.

Project altitude zone of 112 to 128 mi. was chosen because it represents the discontinuity between the usefulness of sounding balloons and that of satellites, Braglia noted. Density and molecular composition data in this region are few because of the short orbital life-times of satellites.

Moreover, due to the difficulty of achieving an equatorial orbit, the upper atmosphere above the equator is highly unexplored.

Direct and continuous measurement

of an density is expected to provide, in turn, accurate model atmosphere of the region of interest and shed light on the interrelated relationships which give rise to the following atmospheric phenomena:

•Diurnal variation, caused by the earth's rotation, occurs in such a manner that the maximum density is at a point about two hours behind the solar time point. Thus the surface of equal density presents a characteristic pattern.

•Monthly variation results from the sun's relative shift in its own orbit, which brings solar activity centers into view.

•Seasonal variation stems from the solar shift and the position of the geopotential field relative to the sun.

•Random, short-period variations arise from solar flares and the ensuing geomagnetic storms.

Research employed method of observing continuous changes in a satellite's orbital period over many orbits enables for measuring the monthly and seasonal variations. Short period fluctuations, however, are clocked by this technique. For San Marco approach, the latter had, will allow an unambiguous indication of relative induced changes and will give a fairly detailed picture of the diurnal bulge.

Because of the relatively high atmospheric density in the region of project, it is necessary to keep drag deceleration to a minimum in order to obtain the desired lifetime of four to six months. This was accomplished by designing the 250-lb satellite for a high nose-to-front-area ratio of 60:1.

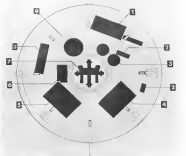
This configuration entails the problem of measuring aerodynamic phenomena, though calculated to be of the order of 10^{-6} g.

CIRA has conceived a novel method for making the measurement, in which the entire satellite acts as the transducer. The San Marco spacecraft is constructed as two concentric satellites, comprising a light spherical outer shell and a spherical central body. The outer shell is sheathed in aluminum foil, while the inner part is electrically shielded from the rest, thus giving rise to a plasma sheath a few microns in amplitude.

This movement is detected by a highly sensitive drag balance consisting of three orthogonally-oriented transducers located at the center of the satellite, which measure the components of motion along the three coordinate axes.

Each transducer is composed of a pair of differential transducers arranged to offset the effects of thermal expansion which could otherwise mask signals in deceleration.

Pressure readings of the transducer



SAN MARCO DIAGRAM shows general arrangement of key components including (1) aluminum aluminum shell, (2) test panel for ground checkout of systems, (3) pressure sensitive caps for drag balance output circuit, (4) differential transducer sensitive to drag balance (5) components for making inputs on computer telemetry channel, (6) test rate damper, (7) drag balance, (8) transmitter panel, (9) telemetry transducer.

are attached to the central body and are carried by a 2-lb. wire from an actuator. Any displacement of the finite area, which is connected to the outer shell, induces a change in the output from the second readings.

Output signal is fed into an amplifier having two separate gains of 500 and 1,000. This double amplification allows two base scales and thus gives accuracy in a semi-logarithmic power scale corresponding to different altitudes as well as different deceleration rates.

Amplifier output signals modulate the microwave oscillator and are then transmitted over one of the seven pairs of amplitude modulation (FAN) radio channels multiplexed on a frequency of 136.55 mc. Transmitter power is 2 w.

Receiving channel is required for transmission of temperature data from transducers in various parts of the satellite, including those on the surface of the shell, which measure atmospheric molecular temperature.

During launch the drag balance is pneumatically rigid to prevent damage by the heart acceleration.

Secondary experiments in the satellite will investigate atmospheric phenomena, including:

•Variation of total electron content, by means of Ionosonde and Doppler-shift techniques.

•Isotropy and the nature of the variation by amplitude modulation.

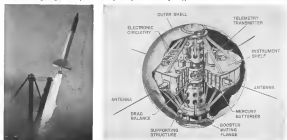
•Graded propagation of radio waves along magnetic lines of force.

Ionospheric experiment will use a 1-watt transmitter operating on a frequency of 27.001 mc., the signals from which will be received and recorded by ground-based stations.

Power for the satellite is supplied by mercury batteries, the lifetime of which will be at least as long as that of the satellite. Ionospheric transmitter's battery, however, is limited to about 500 orbits due to weight restrictions.

Since drag is always parallel to the satellite's velocity, no reference direction is required and hence there is no necessity for a control and stabilization system. A magnetic damper is provided for smoothing out transients removing after deorbiting and separation from the booster. This device forms internal electrostatic coupling which opposes the relative motion of the shell and the central body.

San Marco satellite has been fitted with resistant core antenna in place of the old dipoles, in order to reflect



CUTAWAY VIEW of San Marco satellite (right) shows internal layout bearing structure and layout of components. Note mercury batteries arranged in spherical aluminum shell and location of drag balance at center of gravity. Diameter of satellite is 27.5 in. Photo (left) shows second Suborbital sounding rocket flight from Wallops Island, Va., on Aug. 2. Flight was a continuation of a series of sounding rocket launches which started April 23 to test instrumentation for the San Marco satellite.

The other day, at Republic Aviation's Life Science Labs, where we are running the life-support and mobility tests on the Apollo Space Suit, somebody asked the guy in the suit how the tests are going, and he said:



Little is known with the splash of stage at the water level.

One of the great difficulties encountered by any European space program is a lack of the large, specially-populated area required for launching satellites. Italy's solution to this problem—the use of a mobile platform—a compromise between land-based and ship-based launch facilities. The latter would require special stabilization gear. Specially heated, this method is not restricted to the diameter of launch, and may well be a possible answer to the U.S. problem of launching Non-orbit launchers.

Launch Platforms

Two such platforms, each weighing about 1,500 tons, will be used for the orbital shots. The launching platform, called the Santa Rita, will contain the air-conditioned assembly area and the standard Soviet rocket-launcher. The Italian National Hydrocarbon Agency (ENI) is presently modeling an oil shore oil drilling rig for this purpose. Blockhouse platform, dubbed San Marco, will be positioned approximately 550 yd from the Santa Rita. Tracking radar, command and control units and power generation will be located on this platform, which ENI will build specially for the project at Trieste.

Communications and power transmission between the two platforms will be by means of submarine cables. Helicopters will provide transportation.

Platforms will be towed by sea to the launch area, a point in international waters off the border of Kenya and Somalia at about 2 deg south latitude.

The three legs then will be lowered onto the continental shelf and unhooked in sand to restrain rotation and seismic disturbance. Average water depth at the location is about 165 ft. Platform will then be piled up to clear the water.

Suborbital Launch

Only the Santa Rita platform will be used for the phase two suborbital launch. Support ship will house the control and tracking facilities.

Parasol will mount the Santa Rita during launches, Single's said, and will be transferred to the San Marco. Only after that will the booster be used to bring payload and aimed by acoustic control. In the case of a sudden respect disturbance, the booster would be discarded, lowered into the discard zone and the vehicle down closed by command from the San Marco platform.

Launch will be in a shallow, air atmosphere, descent which will yield an orbit with a few degrees of

inclination. Single's ground track will thus be a standard one-handed orbit in principle, which will increase the area of coverage.

Data acquisition network will consist of six to eight stations in the eastern region, including the San Marco platform, and the NASA facility at Quito, Ecuador. The remainder are being negotiated with NASA and various countries.

Data transmission will be routine one and a real time—there is no recorder in the satellite. Ground station will be distributed so that the satellite will be within range of any one station at almost all times.

Quito station and the platform also will be responsible for radio tracking and orbit determination.

Prime purpose of the April sub-orbital shot from Wallops was to check out the drag balance cupping system and the structural integrity of the vehicle. Performance regarding mechanical movement between the outer and inner parts, which must be avoided.

Apogee altitude of the trajectory was approximately 230 mi and down-range distance was 630 mi. Two-minute flight allowed 60 to 80 sec of measurements.

Malfunction occurred in the "Low"



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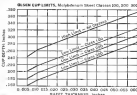
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(Based on 16th century Chinese chronology.)

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debris system on the Shuttlepaster, which is designed to reduce the inhibition spin to a few rpm (just prior to separation). However, separation occurred as programmed and the debris balance was properly managed. Television footage was.

Centrifugal force on the satellite was higher than had been expected, but no resonance occurred. The high spin rate, however, prevented a check of the sensors of the debris balance.

Launch of the backup satellite on Aug. 2, after NASA had modified the debris system, was termed a success. But look at the telemetry data appears good, although it has not been fully reduced as yet.

Project San Marco has been funded completely by the Italian Fairness, Broglio said. Current CNR appropriations for the program amount to approximately \$5 million.

Of the total \$155 million cost for the program over three years, some \$6 million will be used for expending the CRA facilities, including a new space environmental simulation built by Teva Engineering, Inc., Union, N. J. This simulation has been installed at Ciba Airport and currently is undergoing tests.

Primary motive behind Italy's entry into the space field is a desire for scientific participation with other nations, according to Broglio. There is also considerable interest in the technological spinoff from a space program and process and techniques, often applicable in the most unlikely of industries—and their accompanying economic benefit.

Italy hopes to continue its collaboration with NASA, he said, but as yet there have been no negotiations on a follow-up to Project San Marco. The two platforms will be used for launching future satellites, probably from different locations.

An all-Italian booster is not being considered. Work along these lines will probably be limited to the development of sounding rockets.

Present propulsion research in the aerospace industry is centered around liquid-fueled rockets and solid-fueled rockets. High energy liquid hydrogens-liquid-fueled rockets are used in a variety of ways, including under study for a future space station. The solid-fueled rockets are used in the third stage of the European Launch Development Organization (ELDO) boosters. In addition, rockets are shown interest in segmented solid-fueled rockets.

Research in the various space programs has been left the non-research elements of the Italian consortium. Participants include:

- High energy materials—Universities of Rome, Turin, Bologna and Milan
- Aerospace—Universities of Rome and Florence



ARTIST'S CONCEPT of Italian Orion launching the debris-free San Marco platform in low position. Scout boosters in launch position. San Marco platform with blackboard and trailing umbrellas in background. The 1,500-ton platform will be towed to site.

- Biomechanics—Universities of Milan and Rome, the latter in cooperation with the Italian Air Force
- Astrophysics—Universities of Rome, Florence and Naples
- Ionosphere studies—University of Turin, Florence and Rome. Ministry of Communications is also cooperating in this field, with an eye toward the improvement of radio communications.

Other than ground-based observations, the great extent of experiments that have been high-altitude balloons and sounding balloons. Italy has carried out an extensive series of balloon experiments since 1958 from its base in Sardinia, using Nike-Cajon and Nike-Apex rockets. Some satelliteborne experiments are now being prepared for the eventual follow-on to San Marco.

Responsibility for the non-industrial technological aspects of the Italian space effort rests with the CRA. No move to establish a NASA-like agency within the government is being considered for the present, Broglio said.

Italy's contribution to ELDO will

be the test satellite and launch for the launch vehicle tests. This particular organization, he said, is primarily interested for industry, which will gain technical know-how through participation. It has not been decided which Italian firm will build the test satellite.

Science laboratory of the European Space Research Organization (ESRO) will be built in Rome, and will be staffed by European space scientists selected without national bias.

Italy's share of the ELDO/ESRO funding will amount to some \$10 million per year, and will require a separate budget appropriation. However, the Italian Parliament has not yet officially ratified the ELDO and ESRO agreements.

Moreover, presently available to the Italian space program is not sufficient, Broglio feels. He estimates that the world needs about 10,000 scientists and engineers. Project San Marco currently has less than 200, and will require about 100 in the near future.

San Marco Chronology

- April, 1960—First NASA-Italy agreement signed for sounding rocket in investigation of high altitude winds using various experiments.
- May 1, 1961—San Marco satellite design begins.
- Nov. 1961—Preliminary design completed.
- Jan. July, 1962—Final design completed.
- Sept. 1962—San Marco accord signed by Vice President Johnson and European Member, President, conclusion of first prototype design.
- Mid-October, 1962—Contractors selected for first prototype.
- Nov. 1, 1962—Testing begins on first prototype in Goddard Space Flight Center.
- April 24, 1963—Successful launch of first prototype from Wallops Island only partially successful due to malfunction of Shuttle booster's shape mechanism.
- April 20, 1963—Successful second suborbital shot from Wallops using fourth prototype, data now being reduced.

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Machine That 'Learns' May Be Recon Aid

By Philip J. Klaus

Folk Church, Va.-A machine which can quickly learn to recognize and identify samples, patterns, suggesting its use for preliminary analysis of aerial reconnaissance photos, was demonstrated recently by Scope, Inc. Machine, known as Confex 1 (for "conventional cells"), was developed under contract to USAF's Aeronautical Systems Div's Avionics Laboratory.

Demonstration of Confex 1's capabilities included a test in which the machine was shown an identical front or partial profile photo of each of six different persons and in even case was able to correctly identify the person from the photo.

Air Force Progresses

Confex 1 will assist at the Scope plant outside Washington for at least a year during which time it will be used to "test" classified Air Force programs," according to company officials. This qualified statement coupled with the machine's known capabilities, suggests that it may be used to analyze vast numbers of aerial reconnaissance photos obtained during the Cuban crisis to determine if it can be trained to spot air photos which show signs of a military activity.

Confex 1, developed and built over a 16-month period at a cost of \$250,000, is a Percepticon class of device but exhibits considerably more versatility than the Mark I Percepticon developed by

Cornell Aeronautical Laboratory (AWJ July 4, 1960, p. 72). The current model Confex 1 has the memory capacity for learning to distinguish up to 48 different classes of patterns at any one time and for recognizing in under 100 different variations within any single class.

For example, Confex can be trained to recognize alpha numeric characters, each of which would represent a "class" of pattern. Within each class, for example the letter "A", the machine may be taught to recognize up to 100 variations such as a capital "A", a lower case "a" a variety of different type faces and a variety of handwritings "A's", both capital and lower case.

In another demonstration of Confex 1's capabilities, referred to as the "automatic post office test," the machine was trained to recognize the names of six states each beginning with "M", both when written in full and when abbreviated, Mississippi, Michigan, Minnesota, Maryland, Massachusetts and Montana, Miss. Mich. Mo. Md. Minn. and Mass. When slides each containing one of these names or abbreviations, were typed, later hand printed and some written in longhand, were presented into the machine, it correctly identified each except once when it mistook a hand-written "Michigan" for "Minnesota." Otherwise, correct identification was made even when the word or abbreviation was slanted diagonally across the slide.

Even more impressive was the demon-

stration of Confex's ability to identify people from their photographs. To train the machine it was exposed to a fraction of a second to each of two patterns of each of six people—four men and two women. When the training period was completed, Confex was then exposed to an image of each of the six persons in random sequence. Three of these six photos of each person were the ones used to train the machine the other three were photos it had not seen previously. In every instance the machine correctly identified the person in the photo.

Partially Masked

To make identification more difficult, photos were partially masked by a grid in series of stripes, corresponding to extraneous noise. The machine continued to identify each person correctly even at times when a larger obscuring had difficulty in making the identification.

Finally, photos of two persons were superimposed and projected into the machine simultaneously. Confex correctly identified the person whose image was the more dominant. When the machine was asked for its second choice, it correctly identified the other person in the combined image.

The slide elements used in the construction of Confex 1 bear some functional resemblance to the Mark I Percepticon, yet differ in important ways. (Refer to block diagram, p. 15). The structure of Confex includes the follow-

ing memory function and the discrimination cell function are combined in the single "association unit." During the training period, one group of 5,000 sensory cells (one cell for each discrimination cell) accumulates a pattern cell image of the pattern it must subsequently recognize, while each other group of 5,000 sensory cells subsequently builds up a statistical image of the class of patterns which it must recognize. Then Confex 1, with the capacity to accumulate up to 48 different classes of patterns requires a total of 240,000 sensory cells—5,000 x 48. Each cluster of 5,000 sensory cells is taught to remember a particular class of pattern, called an "M-field."

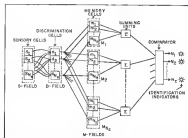
• **Sensing units**, or 5-cells, of which there are 48 in Confex 1, each receive input from the 5,000 sensory cells in its respective memory field. The 5-cell generates an output signal which is the algebraic sum of its 5,000 input signals. After Confex has been trained by associating a statistical image of each class of pattern in each memory field, when it later is exposed to an unknown pattern which it must classify, the unknown pattern will produce the largest number of positive output signals from the memory field which it resembles most closely. Thus the particular sensing unit which generates the largest output indicates which of the 48 classes corresponds most closely to the unknown pattern.

• **Comparator unit** examines the algebraic sum output signals from all 48 sensing units, determines which is the largest and indicates in terms of light flashes the class of the unknown pattern most closely to the unknown pattern. In the Mark I Percepticon, the functions of the Confex sensing units and comparator are combined in the Percepticon "response unit."

Confex Differences

Despite the similarities of Confex and Mark I Percepticon, there are two primary differences. Where the Percepticon was basically an analog machine, Confex is basically digital. The algebraic sum memory of the Mark I Percepticon, which contained only 512 association units, was trained in increments during the machine training period for all classes of objects to be recognized. Confex, however, uses only one specific sensory field of 5,000 sensory cells for each class of pattern to be learned. Thus each sensory field is concentrated only to the class of pattern it must later recognize.

The conditioning, or learning, time for each class of pattern in an associated memory field is 16.5 milliseconds. During this brief interval, the sensory field in effect looks at the class of pattern it must recognize through 5,000 different masks, each of which



CONFEX BLOCK DIAGRAM shows means of 480 sensory cells randomly connected to 5,000 discrimination cells, each of which in turn is connected to 48 different memory cells, one for each class of pattern to be recognized. Output from each group of memory cells, called memory field, is a measure of how closely the unknown pattern resembles each individual pattern built up during training period. This is determined by measuring each Comparator electronic which memory field summing unit has largest output.

allows the sensory cells to examine different portions of the pattern. (For relatively large types of patterns, the number can be reduced to as low as 100.)

In actual operation, approximately 100 sensory cells clustered at random locations in the 480-cell field, are stimulated by the pattern. During this interval, the passage of electrons of fluorochrome in front of each charged photocell is measured, processed by the discrimination cells and stored in the memory cells. Then an other random collection of photocells is energized and the process is repeated. After 5,000 such examinations of the pattern (in a 16.5 millisecond interval), a statistical image of one form of one class of pattern will have been stored in one of the 48 memory fields. Next it is necessary to train the machine to recognize variations within this class of pattern. For example, if it is being trained to recognize alphanumeric characters, and it is being conditioned to recognize an "A", the machine will be exposed to a variety of "A's"—upper and lower case, hand-printed, bold, and italic, typed, and different printed type faces.

By the point the class "A" memory field has accumulated a statistical image of a variety of different "A's," Next a second memory field will be trained to recognize an "B," repeating the process described above. Thus the remaining memory fields will be trained, each to recognize a different letter of the alpha-

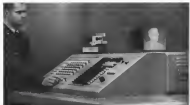
bets or number from zero to nine.

A more detailed examination of the operation of Confex shows that the roughly 100 sensory cells whose outputs feed each discrimination cell are connected so that half of them generate signals having opposite polarities from the other half. Thus the signals from two discriminated cells will cancel one another if they have been wired into the machine with opposite polarities.

Solid Colors

If the patterns to which the sensory cell field is exposed is a solid color, whether white, gray, or black, the equal number of opposite polarity signals into the associated discrimination cells will cancel one another. Only when exposed to a non-uniform pattern of illumination will there be a net signal developed, so that this signal represents the pattern of illumination as being viewed by each group of 100 sensory cells feeding each discrimination cell. Output of the discrimination cell is at one of three levels: a positive binary value, a negative binary one, or zero, depending upon whether the algebraic sum of signal arriving from its 100 sensory cells is positive, negative or zero.

During the Confex training period, the three-level discrimination cell signal is used to give the gain of its associated memory cell. If the D-cell output is a plus one, the gain of the memory cell is increased by one unit while if the output is a minus one the gain is decreased by one unit. If the D-cell



AUTOMATIC PATTERN RECOGNITION machine, developed for Air Force, can be quickly trained to identify up to 48 different classes of patterns with up to 100 variations within each class. In experiment shown above, after machine is trained to recognize six persons from their portraits, it can identify each from training photos at rates under fifteen times that has never seen before.

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Bolts capped locknuts guard against excessive removal of insulation from wires, thus precluding bolt torques.



Bolts capped locknuts keep metallic fillets or other failure from forming beneath exposed discards.

Boots capped locknuts increase the reliability of assemblies by guarding against the abrasion of insulation, damage from screws that are too long, pull-out of screw threads in high temperature and corrosive atmospheres, as well as leakage from liquid storage tanks. All metal, non-paste, and self-locking. Boots nuts are simple in design, compact, lightweight and exceed government specifications for tensile strength. The A-265 stainless steel types have low magnetic permeability. Write for literature describing the wide range of regular and miniature types available.



160 KSI SERIES HI-TENSILE ANCHORS

The 160 KSI series provides high stress-rupture strength, even at temperatures up to 500°F. Nuts in this series are dimensionally identical with their counterparts in the NAS series. For greater strength and ductility, chrome-nickel-vanadium alloy steel (AMS 6354) is used, with nickel-chromium diffusion plating. Despite added cost of material and finish, 160 KSI series nuts sell for two thirds less than stainless steel. For complete details send for the 160 KSI series catalog.

STANDARD AND MINIATURE ANCHOR NUTS

Boots standard and miniature anchor nuts are made to NAS dimensional specifications. They exceed military and industry standards for strength and operational longevity (available in stainless plated steel for 450°F application, and in chrome plated stainless steel for applications up to 1200°F). Dimensions and ordering information are in the Boots Self-Locking Nuts catalog which will be sent upon your request.

BANC-LOC SELF LOCKING INSERTS

Boots Banc-Loc self-locking inserts provide dependable double-locking action in sheet metal, plastic and metal castings, wood and composition materials. The perfect fastener for joining plastic molded halves of metal driven head tools. Send for the Banc-Loc brochure to get the whole story.

output is zero, then the pin is not altered.

During the period in which the machine is being turned to identify, for example, alpha numeric characters and to recognize a variety of different forms of the letter "A," those memory cells whose values decrease and return only as constantly exposed to a disk (or what) area for all varieties of the letter "A" will have their pre-level increased repeatedly.

Alternate Exposure

But memory cells whose memory cells are alternately exposed to dark and the insulated area during the turning process will not undergo a significant increase in pin setting. This means that in later attempts to identify unknown alpha numeric characters, those memory cells with high pin settings will play a more dominant role in identification than will the lessening cells. However, all cells, regardless of age, serve to discriminate between different classes of patterns, i.e., an "A" and a "B." The memory function is provided by a rotating magnetic disc storage unit with 100,000-bit capacity built by Liberator Electronics, Inc.

The use of several polarity sensitive cells and a three level output from the discrimination cells is intended to get around a problem which was experienced with the Mark 1 Perception, according to M. B. Ulfenow, one of the Conifer project engineers. The ability of the Perception to identify different classes of patterns tended to be hampered by the number of samples which class it was exposed to during the turning period.

Latter Tendency

For example, if it were exposed to twice as many "A's" as "B's" during turning, it exhibited a tendency later to erroneously identify some "B's" as "A's." In Conifer, the use of the "reversed polarity" technique tends to make the machine's response relatively independent of the number of different samples viewed during turning, according to Ulfenow.

The number of discrimination cells required in Conifer depends upon the number of different classes of patterns which the machine must be able to identify and the number of different variations within each class which it must recognize. Because Conifer is designed to identify 48 classes with up to 100 variations within each class, the machine needs a minimum of 4,800 discrimination cells to achieve a high probability of successful operation. A total of 5,800 were built in to provide a modest surplus. If the machine were altered below 4,800, recognition ability would drop off sharply, according to

Edward C. Davis, another Conifer project engineer.

The present machine has certain limitations which Sogco, Inc., engineers at work on working to improve, according to Davis. For example, any major addition or alteration of an unknown pattern with respect to the identification portion which the machine was turned to recognize, will make identification difficult if not impossible.

Under Rose, Air Defense Control Center operations, Sogco is developing a pre-recognition technique which is expected to make Conifer sufficient to changes in pattern position, angular rotation and/or size. The technique is the use of a series of pattern masks which is expected to extract information that is invariant, regardless of unknown pattern position, rotation or size.

Conifer 1 uses transistors and is not contained in a device enclosure having a volume of about 25 cu. ft. Company officials emphasize that no attempt was made in the initial version to achieve maximum possible size.

ROSE FILTER CENTER

Low Communication Sample-Development and fabrication of an optical communication system capable of detecting a one-way ground-to-aircraft link, with a 2.5 m resolution bandwidth using a gallium arsenide type laser, as planned by NASA's Manned Spacecraft Center. Due date for the report for proposal is Sept. 6.

Self-Start Acoustics—Acoustic Instruments Laboratory will develop a self-starting acoustic instrument with no moving parts under contract to be awarded by Bureau of Naval Weapons. Award is based on an industrial proposal.

Storable Antenna Conference—An astrophysical and astrophysics conference related to large sizeable radio antennas on the subject of a conference to be held Sept. 14 at the American Society of Engineers, New York. American Society of Engineers, New York. American Society of Sciences, the meeting is limited to those invited to participate and to interested members of the academy.

Organic Synthesis—Induced Color—New York University scientists studying organic materials that exhibit photochromic properties have discovered that those with the best photochromic characteristics induce color. One material naturally made made, polycyclic aromatic hydrocarbons, has induced color in a material it was used for. Interesting question is whether the color-causing mechanism is the chemical or thermal property of the

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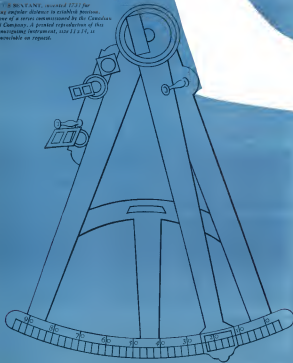
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Doppler Control Indicator



Ideas on space propulsion

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+10% and -10% between mean temperature and -50°C to 55°C. Type 360C is available with a capacitance up to 0.01 mfd, while larger unit comes in sizes to 0.01 mfd, in ratings up to 100 v d.c. Manufacturer: Spangco Electric Co., 235 Marshall St., North Adams, Mass.

• **Super-fiber spectrum analyzer.** which can reduce bandwidth requirements by as much as 1,000:1 for narrow-band FM, PCM or PDM elements, use spectrum has detector in selected dynamic range. Model OS-1R covers 75 to 1,000 cps. Model OS-10R covers 100 to 10,000 cps. Analyzers weigh less than 21 lb., consume 140 ma at 28 v d.c. Manufacturer: Gates Industries, Inc., 212 Darlene Ave., Metuchen, N.J.

• **Stable a.c. voltage amplifier.** Model 150-4, which exhibits stable gain over operating temperature of -65°F to



250°F, is designed to withstand rigors of adverse environment. Device, oriented in sealed plastic container, weighs less than 14 ounce. Bulletin P-6310-4 gives application data. Manufacturer: Tube Instrument Corp., 137 Connelly St., North Tonawanda, N.Y.

• **High-power RF transmitter.** Type 2N-2807, delivers 10 watts of RF power at 100mc frequency with collector efficiency of at least 90% from a 45v power source and has an isolated collector. Device is housed in a double-cooled power package. Manufacturer:

IRW Electronics/Pacific Semiconductor, Inc., 14320 Avenue Blvd., Lake Dale, Calif.

• **Digital oscilloscope plotter.** Model 1001-1 ONL, accepts information from an IBM 7090 computer, translates it into graphic plots with annotation and line joining. Device permits group viewing



of quick-look data on a ready and free basis. The high-speed annotating plotter, contained in a desk-size console, produces 100 points per inch on dry copy. Plotted logic operates at 100 kc and can accept, decode and mark a maximum of 100 ten-bit words per second, not counting computer cycle time. Manufacturer: Drexel Dynamics Corp., Haddon, Pa.

• **Gas-driven rubidium pentodeometer.** Series T-312-1, measuring 0 to 10 d.c. amperes, has adjustment screw along the edge permitting up to 40 units to be selected in volume of one cubic inch.



The triaxial port is available in addition of 30 to 70,000 ohms with isolation down to 0.16%. Device operates over temperature range of -50°C to 175°C and is rated at 1 w at 40C. Weight is 11 gram. Manufacturer: Avco Electronics Inc., 312 E. Lake Oak, Arcadia, Calif.

• **Super-Power Microwave Tube.** is presently the most powerful transmitter tube ever built, generates 415 kw at 3,000 mc (3-band) with efficiency of 71%. The 6-ft.-long, super-power Amplifier weighs 400 lb. Manufacturer: Raytheon Co., Mainway and Power Tube Div., Waltham 54, Mass.

Remember the DC-1?

FIRST OF THE DOUGLAS AIRLINERS...



Graph: Aircraft Division, Inc. Photo

...and Barber-Colman was there!

Remember the early '30s? The first years of modern transport were just taking off then. In 1933, Douglas Company flew their first airliner, the two-engine 12-passenger DC-1... quickly followed with the 14-passenger DC-2 in 1934.

The 21-passenger Douglas DC-3, introduced in 1935, proved itself so rapidly that it was carrying the bulk of American domestic air traffic by 1938. Most famous and successful aircraft in its era, the DC-3 had a cruising speed of 180 mph, and a range of 1500 miles.

Among many innovations that gave these first airliners definite commercial advantages were wing flaps, multi-spar wing construction, and a Barber-Colman three-mount to help control cabin temperature.

Eventually, the DC-3 flew for virtually every nation and airline, before serving as the C-47 work-

horse of World War II. Some 30,000 of this aircraft and its derivatives had been built when production ceased in 1945.

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PRODUCTION BRIEFING

Bendix Corp.'s Edgemoor Plant, Dayton, N.J., will provide prototype vibration platforms for the Solov 18 and Sitem 5 space vehicles' inertial guidance systems under a National Aeronautics and Space Administration contract valued at about \$9 million.

Goodyear Tire & Rubber Co.'s Aviation Products Div., Akron, Ohio, has received a \$600,000 contract from Douglas Aircraft Co. for production of wheels and brakes for the DC-9 short haul jet transport. Deliveries of completed components to the DC-9 assembly line are scheduled to start Aug. 22, 1974.

Northrup Corp.'s Northrup Div., Palmdale, Calif., has been awarded a NASA contract to study aerodynamic attitude and dynamic pressure sensing techniques for application during space launch. The Alpha Q sensor study includes a survey of present technologies, including Northrup's Q-Ball concept used in the X-15 rocket research aircraft, for projected use at altitudes of 160,000 ft.

National Cash Register Co., Dayton, Ohio, will furnish 500 personal recorders before the middle of October under an \$88,000 contract from Air Force's Aeronautical Systems Div., Wright-Patterson AFB (AWR-July 13, p. 13). The recorders, developed by the company's Military Development and Marketing Div., are designed to be used as a pocket or a suitcase-sized unit. The unit has a 17-in. internal tape magazine and transmits 1200 signals to aid rescue units in locating the crewman.

Rohl Corp., Chula Vista, Calif., will develop a motor case segment model for Lockheed Propulsion Co.'s L506-10 solid rocket motor.

Lockhead-California Co., Burbank, has been awarded an Air Force study contract to determine improved allowable standards in the design of spacecraft shell structures. The study will consider the effect of stress, pressure, acceleration, heat, vibration and shock on a spacecraft shell. Study will run through February.

Boyle Construction Co., Newport News, Va., will erect a \$3-million building at NASA's Space Radiation Effects Laboratory at Oxley Point, Newport News, Va. Final contract was awarded recently for the building which contains 27,000 sq. ft. of

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MECHANICAL ENGINEER. Must have BSME or advanced degree, two to six years experience in electro-mechanical instrumentation. Must have experience for developing or designing analog/digital recording mechanisms, such as, sensors, air bearings, detectors, lenses for sophisticated tape transports.

FINISHER. Must have PhD in physics and up to a PhD year experience in developing those test and experimental studies in electrical materials, thin films, new storage media, film products, solid state materials or electro-optical media.

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For consideration, send a letter and resume to: Mr. Charles A. Moody, Office of Scientific Personnel, Ampex Corporation, 465 Broadway, Redwood City, California. An equal opportunity employer.

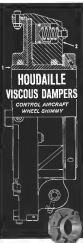


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speed (14 up to 60 lps) electronically switchable electronics and transport. Ampex ES-100 solid state electronics offer Direct recording to 300 KC, FM recording to 20 KC, or IRIG compatible PDM. The FR-1200 also features a new tape transport. Rugged and reliable, it offers low flutter, prevents tape stress during fast starts, provides constant tape tension on both reels and has new tape braking and guidance systems. For details write: Ampex Corporation, Redwood City, California. Sales and service engineers throughout the world.



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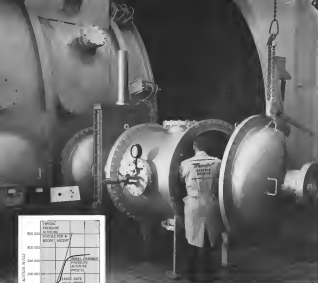
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INSTANT SPACE SIMULATION (JUST ADD VACUUM). The nose-to-altitude chamber, to simulate pressure changes encountered by rocket-borne payloads, is a new addition to the Bendix environmental laboratories where engineers design, fabricate and test space vehicles. Engineers experienced in integration, assembly and test will find new careers at the Bendix Systems Division, Ann Arbor, Michigan. Write or call our Personnel Director.—An equal opportunity employer.

Bendix Systems Division



**WHERE IDEAS
UNLOCK
THE FUTURE**

only space. The building will house the 600 zero spacechrysalis which will be the heart of the facility. Construction calls for completion within 600 days from Aug. 19.

Air Force Lagunas Comandante, Wright-Patterson AFB, Ohio, will service a new procedure for drawing and manufacturing capacitors drawings with Lockheed's C-11 jet cargo transport. New procedure calls for the great test transfer to store and customer engineering drawings on Air Force weapons system as they develop and enter the inventory. The contractor will be required to forward the drawings to the Air Force when they are needed. If successful, construction will no longer have to furnish the Air Force with complete sets of drawings.

Douglas Aircraft Co.'s Astromat Div., Santa Monica, Calif., has been awarded two Air Force contracts totaling \$661,900 for production of TDU-160 sonar targets. The targets are used for anti-air rocket gunnery practice.

Lockheed-California Co., Burbank, will do a preliminary design study under a \$176,600 NASA contract of reusable rocket aircraft concepts for transporting passengers and cargo to an orbiting space station. Study would consider a 10 passenger carrier that could be in operation by 1973-74. Major objective of the study is to attain a passenger safety level comparable to present commercial aircraft.

Leon S. Singer, Inc., Grand Rapids, Mich., has broken ground for a \$1.5-million administration building for its Instrument Div. Building is scheduled for completion in June, 1964.

Brown Instrument Div. of Honeywell is now called the Philadelphia Div. of Honeywell's Industrial Products Group is now with a new company, policy of raising industrial products Group divisions after their geographic location. The group's 200 Kent, Mass., facility will be transferred and added to the Philadelphia Div. by the end of 1963.

Ryan Aeronautical Co., San Diego will study the feasibility of developing a warning system for air against aerial vehicles weapons under an Army Materiel Command contract. Associated with Ryan on the project are Arthur D. Little, Inc., Andover, Mass.; North American Aviation, McDonnell Douglas, Inc., and the Military Products Div. of Halliburton Electronics, Inc.

Port & Whitney Aircraft, East Hartford, Conn., has won a second "Subjet Power Plus" to the Delaware Power & Light Co. in Wilmington, Del. for

gas doing periods of peak electrical demand. The unit, powered by a diesel fuel (75-gal turbine, is rated at 17,000 kw for intermittent use. The unit is automatic and uses natural gas for fuel.

Philco Corp., Palo Alto, Calif., will conduct a design study of an advanced solar probe under contract from NASA's Aeronautics Research Center. The study will result in the most sophisticated measured spacecraft developed to date, Philco says. The probe would measure magnetic fields, composition particles, radiation, and other solar phenomena in a solar orbit 25 million miles from the sun.

Passenger-Dynamap Corp., Cleveland, Ohio, has received a \$4-million order from Lockheed-Gear for additional wing flap tracks for the C-141 Starliner military jet transport. Each C-141 has 16 such tracks in eight configurations.

Proposals are due Sept. 17 on a contract to supply liquid hydrogen to Marshall Space Flight Center and Mississippi Test Operations. National Aeronautics and Space Administration has indicated that the two facilities will require approximately 75.5 million lb. of liquid hydrogen during the time period from 1967-70.

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This gauges metal or heavy sections — there's a MILLERMATIC MIG combination to handle your job better.

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MILLERMATIC MIG welding is the answer to repair or production work in hard-to-reach places, too. Ideal for such applications is the MHT-35-B head gun that carries its own wire and has all controls built in.

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Mitsubishi Seeking U.S. Sales Penetration

Kernville, Tex.—Detailed planning by Mitsubishi Heavy Industries, geared to breaking into the U.S. business aircraft market as a major competitor, is the keynote of its agreement with Mooney Aircraft, Inc., to assemble, sell and service the Japanese firm's new MU-2 turboprop-powered executive transport in this country, Canada and Mexico (AW Aug. 12, p. 77).

Nature of the Mitsubishi-Mooney pact underscores the serious effort by the diversified Japanese industrial giant—which had international sales of about \$7.3 billion last year—to extend its aircraft sales overseas and to penetrate the hemisphere.

The move builds a new competitive factor that may be timing the U.S. business aircraft industry within the near future.

These significant aspects of the agreement were emphasized by Mooney executives here.

• **Mitsubishi initiated** conversations with Mooney leading to the pact, overtures were not made by the American firm. Mooney executives say that they were both surprised by Mitsubishi's request to negotiate and expressed its thoroughness of the investigation the Japanese firm apparently had made of the U.S. company prior to its contact. "They knew about as much about us as we do," commented Mooney President Hal Redford and Vice President Manufacturing and Engineering Ralph

Brown. "They had a dossier that thick, including what appeared to be even articles on anything else printed about us, and numerous pages of hand-written notes in Japanese."

• **Mitsubishi spokesmen emphasized** that the MU-2 had been specifically designed with the United States in mind as the No. 1 market with the idea of putting major emphasis on sales in this country. For this reason, the airplane was designed to meet U.S. Federal Aviation Agency requirements under Part 23.

Also, the production models to be sold in this hemisphere probably would have by far the highest percentage of U.S. designed and built parts and equipment ever incorporated in an aircraft to be introduced into this country.

According to Mooney officials, these factors were considered by Mitsubishi in the Japanese firm's evaluation of a U.S. partner as the MU-2 program. • **Mitsubishi sought** an aircraft company, which did not have a competitor in the MU-2 and might be interested in adding that type of plane to its sales line.

• **Mitsubishi wanted** a company, with a good growth pattern. Mooney, recorded sales of nine MU-2s, 20 aircraft in 1975 for a volume of about \$100,000. This rose to approximately \$5.5 million last year on deliveries of about 385 units. The Texas firm's expansion program

calls for doubling its present production rate of 103,000 sq ft in adding a 101,000 sq ft facility to its operation at Schriber Field here.

Mooney's interest in the program stems from its long-range plans to add a multi-engine turbine-powered executive aircraft to its line in the future. These plans had envisioned a twin turboprop to be phased in by 1970.

Mooney's management believes that with the development, engineering and test costs being handled by Mitsubishi, the MU-2 provides an economical way to get into the field earlier, although Redford emphasizes that addition of the Japanese airplane does not mean that the turboprop-powered airplane program will be scrapped. Mooney's product expansion program calls for seven aircraft models, including a piston-powered light plane and the MU-2, in the line by 1978.

Significant concessions Mitsubishi made in its agreement with Mooney include the right for the Kernville company, to act as its purchasing agent in this country for the American-made equipment and parts that Mitsubishi will install in all production airplanes.

In the case of deliveries delayed to Kernville for sale in this hemisphere, the assembly program calls for Mooney to install this equipment here, over-attach small items. For example, the MU-2 wing, as delivered here, would have bleed air ducts installed, but



Jet Commander Speed Brake Installation Shown

First photo shows speed brake installation step wings of New Commander's Jet Commander prototype. Brakes are installed instead of landing gear to allow aircraft to taxi faster. Speed brakes are installed in the wings and are designed to be used at all speeds up to structural limit of 300 mph. Company facilities are 100% occupied with Jet Commander production line (below).

Mooney would install fuel valves, pumps and other equipment.

If study shows, that certain MU-2 components—that would be necessary made in Japan—can be built in the U.S. more economically than they can be made in Kernville, this procedure might be adopted, according to Mooney.

Mitsubishi also agreed that the MU-2 would be marketed under the Mooney name. This move would be followed by a related rebranding of the Japanese company, the designated MU-2. Studies indicate that the market potential for the MU-2 might be about 10 airplanes in 1983, when the first aircraft will be available for delivery to U.S. customers, and possibly 40 to 60 the following year. Mooney declines to estimate volumes after that period. It is scheduling delivery of a demonstrator to Kernville in late 1984.

Although plans are already under way for programming a control cable area in its new plant to accommodate MU-2 assembly, Mooney feels it has approximately a year or 18 months to develop a complete sales program.

Some details will be made available to its distributor-dealer organizations during the annual factory meeting to end-October. But Mooney probably will authorize the taking of orders with deposits this fall for 1984 delivery. The price would be set at about \$300,000 for the base version, with a standard interior and instrument flight rules (IFR) instrumentation and navigation



Wing of first production Jet Commander takes shape in assembly at Kern's Effort, Okla., facility. One piece assembly wing is placed in 50 ft. over for landing. Speedbrake tape which only wing portions containing integral fuel tanks.

communications installations, not including radar or autopilot.

Optional electronics equipment learn toward Collins radio gear, with the notable Honeywell 3114 adaptive type.

Some changes in the program are developing, based on the firm commitment by Beech to build the Model 90 King Air (see p. 58), a turboprop-powered

version of its Queen Air with Canadian Pratt & Whitney PT-6 engine, and that company's announcement that it is now taking orders.

The King Air appears to be the major competitor to the MU-2 on the basis of earlier deliveries (fall of 1984), being a larger airplane, and with a price tag at approximately \$300,000 versus



Beech Plans 1984 Delivery of King Air Turboprop Transport

Remodeled photo of converted Beech Queen Air shows configuration of the company's proposed new Model 90 King Air 65 plus power-boosted engine (AW Aug. 18, p. 29), which Beech plans for fall 1984 delivery. King Air will be powered by two 1500-hp Canadian Pratt & Whitney PT-6s. Contractors of first Model 90 is under way. Price, when available is about \$300,000.



SOLID PROPELLANT PRODUCTION FACILITY—U.S. AIR FORCE PLANT F9B: Lummas' architect/engineering design for the propellant complex included auxiliary facilities for MINUTEMAN horizontal engine testing, propellant handling and storage considerations, and rocket-engine handling.



LUNAR ENVIRONMENTAL RESEARCH FACILITY—U.S. ARMY CORPS OF ENGINEERS: Lummas performed the conceptual engineering for the simulator which established the engineering feasibility to provide for vacuum up to 7 x 10⁻⁷ torr, temperatures as low as -421°F, and solar radiation levels the vicinity of the secondary sun-up to 730 watts/sq ft.



WORLD'S LARGEST LIQUID HYDROGEN PRODUCTION FACILITY—U.S. AIR FORCE PLANT F7B: Lummas designed, engineered, and constructed the hydrogen production process stream at the plant to produce 100,000 gal per year hydrogen, which is then liquefied through cryogenic processes.

PROCESS ENGINEERING MODEL, U.S. NAVY PROPELLANT PLANT, HYDROPLASTICIZER UNIT: In addition to process design for aerospace units, Lummas performed design functions for conversion of the unit from batch to continuous process, for a slurry coating plant to produce intermediates for possible fuel application, and for abundant instrument-maintenance facilities.



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electronics. Nordest Nitschele put Moscov apparatus in use, aware that Bush would cancel the King Air program at such a fast pace (AW Aug. 18, p. 26).

Many of Moscov's more than 50 sales orders are not designed to handle the more sophisticated turboprop MU-2. Moscov probably will appoint additional distributors with facilities capable of servicing the airplane.

Powered by Mitsubishi's Nagaya Air-craft Wicks, which designed the MU-2 showed considerable willingness to incorporate Moscov design inputs into the airplane during negotiations. Those included suggestions for increasing the airplane's range by installation of 50 gal. wingtip tanks.

Even more important was acceptance of the Kermic manufacturer's proposal that the airplane be fitted with either the P&W JT-6A or Allscowich 331 turboprop engine to ensure that the companies would not be dependent for their powerplants upon American suppliers.

Moscov leans toward the Allscowich 331—although the customer would have an option on choice of the two-pair turbo because of the lower price (about \$6,000) and because Moscov captures that the 331 is a simpler (one-plant) Propeller would be three-blade Hart-

Mitsubishi MU-2 Specifications*

*Two-blade	2 Turboprops	weight	1,310 lb
Adverse 26% at 161 mph stall	440 hp maximum continuous rating	Landing distance, sea level, zero wind, over 30 ft obstacle	7,540 ft, gross weight
Maximum cruise speed at 20,000 ft	315 mph	Landing rate, sea level, zero wind	6,000 lb gross weight
Maximum cruise speed at 8,000 ft	300 mph	Landing rate, sea level, zero wind	870 ft
Maximum cruise speed at 7,000 ft	295 mph	Landing rate, sea level, zero wind	1,990 ft
Rate of climb at sea level, two engines	2,780 fpm	Maximum range at 20,000 ft, 30-min cruise	3,110 mi
Rate of climb at sea level, single engine	1,510 fpm	Maximum range at 20,000 ft, 45-min cruise	1,780 mi
Service ceiling, two engines	15,000 ft	Standard gross weight	4,570 lb
Service ceiling, single engine	10,000 ft	Maximum gross weight	7,230 lb
Stall speed, flaps down	53 mph	Empty fuel capacity, standard auxiliary	5,940 lb
Stall speed, flaps up	113 mph	Up tanks	100 gal/180 gal
Forward distance, sea level, zero wind, over 50 ft obstacle	7,940 ft, gross weight	Span	15 ft, 9.5 in
	8,000 ft	Length	32 ft, 2.6 in
Takeoff distance, sea level, zero wind, over 50 ft obstacle	7,940 ft, gross weight	Height	12 ft, 10 in
	8,000 ft	Wing area	807.9 sq ft
Takeoff ground run, sea level, zero wind, over 50 ft obstacle	7,940 ft, gross weight	Cabin length	31 ft
	8,000 ft	Cabin width	4 ft, 11 in
Takeoff ground run, sea level, zero wind	7,940 ft, gross weight	Cabin height	4 ft, 3.2 in
	8,000 ft	*Moscov plane modification of P&W JT-6A or Allscowich 331 turboprop	
Landing distance, sea level, zero wind, over 50 ft obstacle	6,000 ft, gross weight	*Performance is extended, prior to flight	
	6,000 ft	*Moscov has tanks	
	6,000 ft	*With 50 tanks installed	

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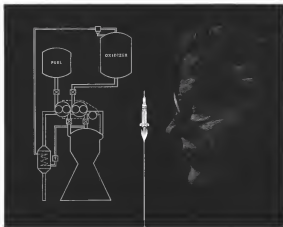
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LIGHTPLANE ALTITUDE TRANSDUCER (left), made by General Controls, has conventional bellows mechanism to sense pressure changes, plus extra diaphragm to digitize altitude data and give trim to motor indicator heads. Control head of identification and altitude reporting system (right) enables pilot to select from 46 possible altitude codes at ground controller's instruction. Transducer transmits code and automatically transmits proper code when interrupted by traffic control code.

FAA Evaluating Lightplane Transponders

By Barry Miller

Experimental altitude reporting transponder beacons, designed to facilitate radar surveillance of light aircraft flying in controlled airspace, are in the initial stages of flight evaluation at the National Aviation Facilities Experiment Center, Atlantic City, N. J.

The equipment is being developed in parallel efforts by Hamilton Corp. and Transco Products, Inc., under the Federal Aviation Agency's Small Lightweight Altitude Transponder Equipment (Slate) program (AW Feb. 5, 1962, p. 35). Suppliers of altitude transducers and digitizers are Kollsman Instrument Corp. and General Controls Corp., respectively.

One of Slate's principal goals is to encourage the development of light weight and low cost avionics equipment to enable lightplane users to be brought under positive air traffic control. The transponder would transmit automatically to air traffic control centers identification codes, assigned to each light aircraft as it enters ATC area, and altitude information in suitable increments.

The goal is in conformity with Project Beacon recommendations which favor equipping all aircraft with transponders that can respond automatically to ground interrogation with position, identity and altitude information in a manner of controlling the air traffic flow and ensuring safety.

The drawback for smaller aircraft users, however, has largely been one of cost. Even the most capable equipment being developed under Slate, should it enter quantity production, runs cost the user as much as half the value of his aircraft.

The FAA's philosophy on Slate, explains Kenneth Wise, project engineer, is to determine the minimum necessary operational level for the airborne system to do a satisfactory job and to find out what each increment in equipment capability will cost. That the agency has a chance to study cost and performance before mandatory requirements come under discussion.

In line with this reasoning, four separate types of equipment of various



SMALL LIGHTWEIGHT ALTITUDE TRANSDUCER EQUIPMENT (Slate) developed by Hamilton Corp., mounted by Kollsman, is being evaluated by FAA. Equipment shown in left photo includes transducer (1), Slave 3 control head (2) which permits pilot selection of 4600 identity codes, Slave 2 and Slave 3 control head (3) which has 64 codes, Slave 3 altitude transducer and altimeter display (4), and transponder (5) which automatically transmits information upon interrogation to traffic controllers. Connections on left. Right photo shows Hamilton's transponder, with cover removed, which is located in front of ATC area. Visible functions include power supply (1), stack of three pulse modulator boards (2), Slave Slave (3), RF amplifier and mixer (4) and local oscillator (5). Transponder is derived from radar company-developed, FAA-supported ground position transponder.



SLATE 2 altimeter equating system, developed by Transco Products, Inc., includes altimeter transmitter and display units by Grumman Electronics (left), lightweight transponder with 64 selectable radio and antenna, receiver module (center) identification unit, and automatic altimeter reporting to ground controllers in 140 ft increments up to 14,700 ft. The use of the four SLATE equipments of increasing capability being developed by Transco and now in early stages of FAA evaluation at the National Avionics Facilities Experimental Center in Atlantic City, N. J. Hamilton Corp. is conducting parallel development.

ing capabilities and capability are in varying stages of development under SLATE, with the first two types already in FAA's hands at NATFEC and an order scheduled for delivery in late October.

- The first type is:
- **SLATE 2**—This system is designed for providing altitude information in 100 ft

increments over a range of 50 mi from the transmitting source. The equipment consists of a transponder and antenna, a ground transmitter for obtaining altitude and an associated display. Both contractors delivered their equipment last spring.

The transponder offer in approach, but both have power outputs above

the 32-w minimum acceptable level specified by the FAA. Hamilton's transponders run about 50 w, Transco's between 180 and 125. The transponders do not provide identification as required by FAA and only have identification on mode C. Was says this visual attempt at a suitable transponder may have sufficient power output for general use, and the 500-ft reporting increments may be satisfactory.

• **SLATE 2**—This version adds the ability to make mode A identification and permit the pilot to select one of 64 possible codes, but the transponders retain the same power and sensitivity levels and the 100-ft altitude reporting in constant increments unchanged. All SLATE 2 equipment had been delivered by July.

• **SLATE 3**—This system reduces altitude reporting increments from 100 ft to 100 ft, to be certain that ground controllers will receive sufficient data on aircraft rate of descent to anticipate conflicting flight paths. Additionally, SLATE 3 equipment must meet more stringent environmental standards, as to be more sensitive and capable of supplying a maximum of 325 w at the transponder antenna.

SLATE 3 transponders will have 64 identity codes and probably will span a range of 300 mi. Unlike SLATE 2 and

3, this will use altimeter digitization which provides visual display at altitude for the pilot, much like a conventional pressure altimeter. SLATE 1 and 2 have simple altimeter digitization with no pilot display. There is no doubt that SLATE 3 will satisfy consumer light plane surveillance needs, according to Was.

• **SLATE 3, Mode 1**—SLATE 3 capability is supplemented with a Mode 1 transponder system having an expanded 4,096 code scheme. The two contractors are scheduled to deliver this equipment in October.

FAA now is evaluating SLATE 1 and 2 equipment, but does not expect to report results until tests of all four types are completed, probably early next spring. The equipment is being flown in a Piper Tri-Pacer and will be checked at a Grumman Cessna to qualify the test plan, and to make longer range evaluations. Subsequently, the various equipments will be evaluated competitively against one another.

In typical possible operation, a light aircraft entering a controlled area will upon its position, altitude, heading and destination be taken to the ground controller. If the pilot indicates that he has a transponder, he will be assigned an identity code, which he enters into his transponder control head on the altimeter instrument panel.



ELOSOPH of Transco's SLATE 2 transponder shows simple 8-in square front and construction, compact packaging. Transponder weighs 4 lb, measures 10 1/2 in long. It employs digital techniques for encoding signals.

Then the SLATE system will send altimeter identification and altitude information automatically to reply to air traffic control radio interrogations.

Typically, the Transco transponder will operate as follows: Intriguing pulses from the ground are received by the transponder and a pulse width discriminator checks to be certain that pulses are of the proper sequence and duration. If the pulses are legitimate interrogations, a pulse position encoder encodes distance from the spacing

between the transmitted pulse pair whether the interrogations are mode A (5-number sequence) or mode C (31 number sequence).

If the signals are mode A, which is required for identification, the transponder generates its coded identity previously entered by the pilot in the 64 or 4,096 code selection. If the interrogations are on code C, received for altitude reporting, the display associated with the altimeter transducer or altimeter automatically sends its

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Notes & Details	No. of Units	No. of Bldgs
Area Containing 1986, 8	1	
1987	7	\$104,000
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971 - 972	10	
973 - 974	10	

Note: Along glenns by the hundreds in California and Fresno Springs. These glenns are not affected by this law. In 2000, there were 1,000 glenns having a total capacity of more than 100,000,000 compared to 2,000 glenns having a total capacity of more than 100,000,000 in the same year in 1990.

PRIVATE LINES

Opposition to user charges on airfare has been re-emphasized in a letter to the Federal Aviation Administration dated May 15, 1985. The letter was sent by the American Association of Airports, General Chairman H. Webster Crain, vice president/finance and contracts of Aero's Lyndon, Wis. In a letter to FCC Chairman William Henry, Crain stated that fees as that equipment will decrease use of widely needed radio communications equipment and urged rewording Dictator 1400. The proposed FCC fee would levy a \$10 charge on installation or changing of airborne communications equipment and would require a \$25 license fee. Inspection of the fee is shown in 1, 1985.

Federal Aviation Agency has issued a publication, entitled *Guide to Drug Hazards to Aviation Medicine*, which consists of a list of all commonly used prescription and nonprescription drugs and notes possible side effects. List makes recommendations concerning the

length of time a person should wait after taking a prescription drug before acting as a crew member on an aircraft, in line with provisions of Federal Aviation Regulation 91.11(a) (2).

Cessna Aircraft Co. has occupied a new 125,000-sq-ft factory building in its Walling Plant complex in west Wichita, Kan. Assembly lines for the twin engine Models 520 Skyquest and 510B have been moved into the building. Production facilities for the Model 441, currently in flight test status, also will be in the building. Cost of the new building was approximately \$2,250,000.

Southwest Automotive Co. of Dallas has been appointed direct factory dealer for Waco Aircraft Corp. of Ft. Worth, the latter has announced. Southwest Automotive will handle sales of the Waco 40B STC, aircraft (AW Aug 15, p. 116) throughout the U.S. and is planning a demonstration near this fall.

5 AREAS OF DALMO VICTOR SYSTEM CAPABILITIES

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1 ARBORE ANTENNAE IMPROVE THE

is the successful operation of real-time and kinematically redundant systems. Consequently, high-performance robotic packages like DARTS and ImaC, have been available; ground mapping has involved a lot of work at other centers.

2 ADRENAL GLAND FUNCTION

MacUser journal listed command and control and how provide lookings and common looking for native making deep space print-offs. Below Walter has the steps. Will let of producing complete compiles, from basic design to program.

3 MICROWAVE SYSTEMS: Future Moves

has been deeply committed in microwave systems for many years. Leadership for OEM established in telemetry, automatic tracking, countermeasures, and distance measuring with capabilities for satellite remote sensing control and software-defined

4. MAGNETIC SYSTEMS Jonathan Salas

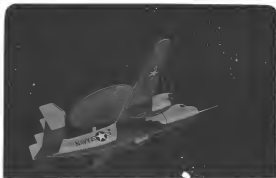
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offices and brands. Quito Victor provides
important KPIs across its portfolio.

The page opposite describes one of the many Dulma Water settlements. Suburbs and employment of annual skills are needed to further WAP and other Dulma Water concepts. If you would like to visit in 1986, please let me hear, and you will see the many advantages of living in the San Francisco Peninsula with the Dulma Water. I can be reached at 415-338-1111.

☐ All Cover Operations Destroyed

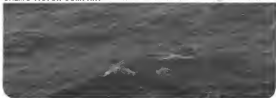


DAIMIO VICTOR EXTENDS NAVY'S "SEE" AT SEA

development, is a key factor in the early warning system that gives the fleet increased threat detection and weapon deployment. The "Hobbesian" sensor structure combines aerodynamics, stealth, microwave and mechanical design concepts into a single unit which is an integral part of the carrier-based *Chimera* Hawkeyes. The super-sensitive, long-range detection equipment is another example of Dalmia Victor's fully integrated systems capability. Dalmia Victor is in the vanguard of new developments in its major product areas. If you are interested in becoming a part of these challenging programs, Dalmia Victor is currently inviting applications from qualified scientists and engineers. For further information, contact: Director, Scientific and Engineering Personnel, An Equal Opportunity Employer.



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EQUIPMENT



BLOCK DIAGRAM (left) shows outputs from the detection transducers—N, W, and S—to the system electronics, which would send an output signal to the guidance and control system. Diagram (right) traces system time-sequenced outputs.

Thrust Vectoring Monitor Demonstrated

By Rodrick D. Höben

Stability of a continuous thrust vector monitoring system—which uses metal pellets injected into a rocket exhaust stream—has been demonstrated by Randow Laboratories, Inc., Newark, N.J., under a contract from the U.S. Air Force.

The monitoring device developed by Randow for Aeromach Systems Div.'s Flight Control Laboratory at Wright-Patterson AFB, Ohio, suggests eventual development of a system designed to permit thrust vector control and guidance of jet aircraft, rockets and missiles through continuous jinking of exhaust nozzles with the small pellets. Total im-

pulse measured with the three is also measured by the system.

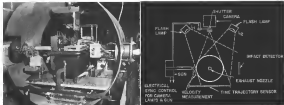
The device, called a gas distance anemometer, is analogous to a cathodoluminescence, but uses pellets fed into the exhaust stream from three explosion ports spaced 120 deg apart or from one point rotated around the nozzle. The force or deflection exerted on the pellet is directly proportional to the engine thrust. Knowledge of the pellet's trajectory, and the period of time required for it to be deflected a given distance, allows determination of the thrust magnitude.

The thrust is the integral of the gas thrust (thrust equation) used over the pellet's time of flight. The duration of

the thrust vector from causality is obtained from fuel delivery system.

Experiments at Randow Laboratories were conducted in a cold phase environment. Low temperature nitrogen gas was used as the initial experiment because of a need for a transparent fluid background that would permit the use of visual photographic equipment to simplify the pellet detection techniques. The cold phase experiment was conducted with a full flow experiment nozzle which expanded dry nitrogen gas to the atmosphere through a dotted rectangular exit.

Insulated stainless air turbine pellets and pellets coated with an ultraviolet dye were considered for actual



THRUST VECTOR MONITORING SYSTEM is contained in a 4-ft-dia cylinder (left). Gas flow is directed out from the rectangular slit in the center. Pellets are ejected from the pipe at center right and travel from right to left. Black box below the rectangular slit is the distance detection system. Flash tube at right in photo sends out a burst of collimated light to illuminate pellets. Light reflected off pellets is captured by 45 deg prism located below each of the three slits in distance detection system and then sent through two magnifying stages. When the detection levels down, it returns a selected value of exhaust gas velocity, which opens pressure pipe atop the rectangular slit. Remote control evaluation system includes camera, flash gun, velocity transducer, gas flow and system system. Schematic (right) shows another test configuration.

INTERNATIONAL AIR TRANSPORT ISSUE

October 7, 1963

To meet the information challenge created by the international character of aviation, AVIATION WEEK & SPACE TECHNOLOGY publishes each year an issue devoted to international air transport progress. This issue is received with such enthusiastic response that it will again be greatly expanded to provide the most comprehensive analysis and forecast of the air transport industry and its technical developments.

Publishing date is October 7, 1963—timed to coincide with the annual general meeting of the International Air Transport Association (IATA) in Rome. Copies of this issue will be flown to Rome for distribution at the opening plenary session to airline presidents, IATA delegates and other world aviation leaders.

Here there will be the current problems in international air transport including bilateral agreements, rates and tariffs, flight equipment, passenger mail and cargo traffic, air traffic control, the airports, mass exchange of international routes. Other subjects essential to a full analysis of the airline industry world will be stressed including trends in separate transport development, markets, airport operation, services of Russian and Communist bloc airline activity, impact of U.S. international transport policy on world political and diplomatic relations.

Feature treatments will be given to trends and projected future prospects for traffic growth and development of flight equipment in all major world markets. North and South America, Atlantic, Pacific, Europe, Africa, Middle and Far East. Ample illustrated material will also feature specially prepared charts and graphs to show growth and forecast trends.

This impressive list of subjects slated for coverage will involve the world-wide editorial staff of AVIATION WEEK & SPACE TECHNOLOGY. Treatments of the most timely and complex world air transport issues, a report from the authoritative respected voice of international aviation promises to make it the most important subscribing opportunity of the year for your equipment position and service to the airlines. Identify your role in air transport at a time when attention will be focused on major industry issues.

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Triple-Test Simulator Assembled

Simultaneous exposure of spacecraft materials to electron and ion beams emulating QSS test conditions in the 10⁻⁶ test range in a variable temperature environment is possible with a simulation system assembled by Aero Corp.'s Spaceflight Program Office, Tulsa, Okla. The equipment will be used to study possible changes in electrical and optical properties of exposed metal surfaces of spacecraft and other devices due to effects of low energy particle bombardment of those in the outer space.

space vehicle flight control applications where temperature and load stresses, corrosion resistance, magnetic or non-magnetic and dielectric properties under controlled density, are important.

A dynamic testing system to occur once some of the pellet detectors problem is being studied. It would have a pulsed or CW beam in a light source. A high intensity, monochromatic light duration would be repeated in a pulsed mode at a 100 Hz repetition rate or higher. The beam could then be superimposed in the third infrared photo graph of the pellet trajectory.

Loss Use

The use of the same slit detector with a CW beam laser could solve this system practical with a low cost solution. The most requirement is that the optical system from the collector at 6045 Angstroms or any other frequency at which a laser can be fired be much less than the light signal scattered off the pellet for optical detection to be possible.

No transportation required in this laser detection system would be a weak beam laser using a pulsed laser light—possibly produced by diode pump and modulation with photomultiplier peaked near the laser output line. Fiber optics could be used to guide the light into the photomultiplier. Since the output depends on the absolute quantity of input light, longer slit could be used to detect large thermal changes. The fast slit size can be used also to the contents of the initial pellet action

so that the entire system can be located very near the exhaust plane.

Thrust generated by the Radoson test setup varied from 70 to 140 lb., 100 to

twice the normal value during short duration tests. Chrome steel pellets of various size and weighing 2 milligrams were used. Pellet injection rates up to 5 per sec. can be attained at present. One cubic inch of the pellets contains about 41,500 pellets and weighs 1.1 oz. A 10 oz. in storage unit would last 40 to 15 min. mission would require about 0.01 oz. of pellets.

Strain Gauge Method

The conventional method of measuring thrust is through the use of strain gauges located on the engine mounting bolts. In case of internal direct vision, an internal shaft strain gauge. Any slight deviation from consistency of the thrust vector can be detected by observing the perceptible mounting structure.

The strain gauge method is located to ground measurements while the system proposed by Radoson could be used in flight vehicle and as a research tool for gas dynamic analysis of flame profile interaction. Strain gauges are sensitive to about 10⁻⁶. Then measuring accuracy becomes a limitation when thrust levels of 50,000 to 1,500,000 lb. are being measured.

According to Radoson, the thrust vector measuring system can measure thrust to about 0.5% of 1%.

Other possible applications of the system are the close monitoring of burn

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CF700 Engine Begins Vertical Test Runs

General Electric's CF700 turbofan engine has begun a series of vertical test runs at GE's Small Aircraft Engine Dept., Lynn, Mass., just as being installed in the two-light laser braking aircraft vehicle being developed by NASA's Bell Aerospace (AVR 22, p. 7). CF700 will provide vertical lift equal to 1 of the leading competitor's power, weight. Modified television camera for vertical operation marks the only change from the regular CF700, according to GE engineers.

out traces in ballistics residues and thrust degradation as jet aircraft over long periods of time. Giant inertial guidance systems need a few seconds to respond to relieve thrust vector changes. A thrust vector system could respond to these changes in several milliseconds, making possible more economical use of unburned fuel used to correct flight vehicle attitude. The pellet comes the gas stream is about 1 micron in the Kelvin device.

System Instrumentation

Instrumentation for the system consists of a pressure regulated oxygen stream for velocity-modulated firing of the pellets, a detector detection system to coordinate the space and time components of the pellet trajectory, an inertial velocity transducer and radiant electronics.

Time sequence synchronization is accomplished with a non-linear threshold control circuit. The internal shutter release in the camera manually initiates the system once the chamber pressure gauge of the fired rocket indicates stability. Pellet trajectory of the detector would be to locate control.

When the camera switch is closed, a silicon control rectifier breaks down and a large transient current is drawn from a battery to ignite a collimated flash lamp. A condenser base external detector measures the thyristor breakdown. When this occurs, the capacitor discharges to

activate the solenoid valve of the nitrogen oxygen stream. The time delay is preset so that the pellet enters the chamber area where the flash lamp is at its maximum intensity and the camera shutter is wide open. The correct pellet passes through a photo cell or solenoid coil solenoid transducer which creates a pulse pair corresponding to two points separated by a known distance.

The two internal location pulses are read out by a counter and used for the initial velocity determination. Reflections of the highly polished ball act as the signal to the detector when the pellet enters the chamber region where its position and time along the trajectory are to be measured.

Impact Sensor

Upon leaving the exhaust area the pellet strikes the surface of a photo-detector impact sensor. This sensor detector records the final deflection on pressure sensitive paper as well as a stop pulse which is sent to the counter along with the start pulse for a transit time measurement.

Theoretical and experimental development work on the system has been in progress for over three years at Redondo.

The thrust vector control being tested was recently proposed to the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston, Tex.

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WHO'S WHERE

(Continued from page 21)

Changes

John A. Grawell, assistant department manager, Engineering Dept., System Development Corp., Santa Monica, Calif.

John F. Nichols, manager of the newly formed Advanced Planning and Research Div., Hiller Aircraft Co., Palo Alto, Calif. Also **Paul Schalk**, project manager, Hiller Aircraft Co.'s helicopter program.

James Desautels, chief systems/planning officer, Radco Power, Inc., with headquarters at the company's Riverside Laboratories, Fontana, Calif.

G. W. Galey, Maintenance with long last manager for Boeing operations at Great Falls AFB, Great Falls, N.D.

Capt. Edward A. Spaul, command, Airborne Transport Div. of Texas, Inc., New York N.Y.

Cdr. William H. Rando, deputy project manager for engineering, Nike Zeus Program Office, U.S. Army Missile Command, Redstone Arsenal, Ala.

Frank Eason, director of engineering, Space Operations, Space General Corp., El Monte, Calif.

Capt. Charles F. Senard, manager of flight operations, Utah Air Lab., moved to Capt. Frank Cowan, school.

Frank Hagen, manager marketing research, Atlas Research Corp., Weybridge, Chester 1 Road, executive director of space program, Martin Co., Baltimore.

A. M. Chelms, manager of sophisticated research support system, General Dynamics (Dickinson), San Diego, and **R. A. Glaser**, manager of requirements research, technical and nuclear systems.

Dr. Lawrence R. Schindler, Jr., director, IBM Research Laboratories, Tokyo, Japan, and **Reuben H. Polchok**, manager of all operations.

Dr. Martin Calabrese, senior staff manager, Engineering Div., Ampco Corp.'s H. Reynolds (JPL) Technical Operations.

Lesley Bensch, senior project engineer, Antares Research, Inc., Boston, Mass.

William E. Williams, chief engineer, Western Div. of Tascap Engineering, Inc., Santa Clara, Calif.

Stanley J. Kozmin, director of quality control, Transport Div. of Boeing, Inc., Everett, Calif.

Dr. Joseph E. Coffey, chief of area control activities, Bradco Systems Div., San Jose, Calif.

Cdr. John W. Chavitt (USA, ret.), manager for operations research, Testco's Bell Laboratories Co., Fort Worth, Tex.

Dr. William H. Christensen, manager, Microwave Test Div., Hughes Aircraft Co., Culver City, Calif., and **Dr. John T. Moss**, director manager.

Anthony M. Kleban, marketing manager, Special Projects Div., Beckman Instruments Inc., Fullerton, Calif.

Dr. Robert E. Mott, senior research engineer, Ford McCulloch, Inc., San Carlos, Calif.

R. I. Thores, director of engineering, Lockheed-California Co., Burbank, Calif., replacing **J. B. Wenzel**, now on leave of absence.

ENGINEERS & SCIENTISTS

ALL CHIEFS, NO INDIANS!

With wages in check, this phrase might be applied to the scientists and engineers of Pen Arm's Guided Missile Range Division. Under the direction of the U.S. Air Force Missile Test Center, CMRD has more 5000, have responsibility for conceptual planning, specifications, and engineering of the major instrumentation systems developed by industry for the Atlantic Missile Range. The decisions made by Pen Arm's leaders in this area, directly affecting the success of each missile, space vehicle, and scientific probe launch operation at Cape Canaveral.

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SYSTEMS ENGINEERING utilizes these range plans to develop detailed specifications for all range instrumentation, data, and support systems. They then evaluate bids from industry to insure that capable laboratory sources will furnish such systems. This is only the beginning of their task—they follow and monitor the development of this equipment through installation and checkout.

RANGE OPERATIONS plans and evaluates range support for all launches, coordinates all range support activities, provides data and communications for range wiring, and manages the operation of down-range stations.

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Telemetry increases the operating range of telemetry to more than 1000 mi., design a system which, upon completion, will return the most important data from each vehicle.

Options, design and build an instrumentation system for both CGO and start/finish, having infinite velocity and range to medium, seven, double speed, accuracy less than one-tenth mile.

Infrared develop high resolution spectrometer for launch and recovery systems; implement a complete infrared measurement system for all target coverage.

Measurement Unit, laboratory and/or battery power supply can the independent camera relay (JPL) and control the range of this system.

Sea Penetration can estimate moisture in water over a 1000 sq. mi. area of the Gulf of Mexico; can estimate the rate of change of sea level.

Microscopy improve cloud height and growth detection terms; measure, develop a system to measure atmospheric electrical potential and cloud movement.

Capable engineers and scientists with applicable experience are invited to write in confidence to Managers, Range Development, Dept. 104-4



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PROBLEMATICAL RECREATIONS 185



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—continued

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ANSWER TO LAST WEEK'S PROBLEM: The two slugs have exactly one shot to themselves.

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Supersonic Boom

The article appearing in the July 15 issue of *Aerospace Week* by Art Mering, M. A. Mering's comments in support of a Mach 2 supersonic transport represent in my opinion, a gross misrepresentation of facts.

Work required to enter lower stratosphere during cruise will be less for a Mach 2.587 than for a Mach 3.587. Over gross production methods not sufficiently reliable to indicate that a Mach 3.587 cruising at 60,000 ft will produce a sonic boom equivalent to approximately 3 ft jet noise from a Mach 3.587 cruising at 60,000 ft (the two values amount to be, approximately the same volume and weight). During the climb and acceleration phase of the flight, the maximum value of ground compression may be expected to occur between Mach 2.2 and Mach 2.5 so that the sonic boom problem may be considered as being equal or less for the two vehicles in this phase of the flight.

In addition, the deceleration and descent phase of the flight is again equal to that of a profile from nose boom considerations for the Mach 2.587 as it will be for the Mach 3.587. Both aircraft must perform a constant altitude deceleration to low supersonic Mach numbers prior to any descent. Any completed supersonic phase to descent is indicated by Mr. Mering to be required for the Mach 3.587 will also be required for the Mach 2.587.

The article further states that passengers on a Mach 3.587 carrying 2,345 lbs would have had time to clean their baggage and be on their way before the Mach 3.587 arrives at Mr. Mering is careful to indicate that of the two vehicles depicted the same stage at the same time had traveled the same route the Mach 2.587 would arrive approximately 15 min ahead of the Mach 3.587; then the true world certainly does not use a time history of the stage Mach number and altitude for the two vehicles noted by Mr. Mering in his comparison (Philips *Aerospace Week* could publish the required information in table form in a few editions).

Because of the approximate 120,000 ft difference in cruise altitudes the Mach 2.587 will cruise some 60 min before a Mach 3.587 reaches its cruise condition as described by Mr. Mering. While the Mach 3.587 requires an off-climbing at a relatively great

the Mach 2 in descending along about 1,200 mph. Studies I have conducted have shown that the two vehicles would go from nose at approximately the same time if both are restricted to the same sonic boom exposure limitations. For all portions of the upper climb segment for the Mach 3.587 as well as the Mach 2.587, the Mach number is such that the angle of attack is less than 10 deg and the Mach number is equal to or greater than 2.011, the Mach 3.587 will actually be increasing its angle of attack more than the Mach 2.587 in its cruise mode. The Mach 3.587 during its climb actually travel faster than the Mach 2.587 in the side profile of the flight available for the Mach 2.587 to give to Mach two, would have to do during the

Aerospace Week antennas the opinion of its readers on the same raised in the magazine's editorial columns. Address letters to the Editors, *Aerospace Week*, 200 W. 42nd St., New York 36, N. Y. For to date letters under 500 words will be given a prompt consideration. We will not print anonymous letters but sources of letters will be withheld on request.

acceleration and descent. At best is 1 sec cruise, in order for the Mach 2.587 to test 17 sec, about of a Mach 3.587 will both aircraft starting at the same time. During the same mode of 2,545 lbs. the Mach 3.587 would have to be performing "yaw right" for roughly 30 sec prior to landing.

I expect that the duration of facts to Mr. Mering to make the Mach 2.587 as fast as, alternative than a Mach 3.587 is an exercise a lot to have National Aeronautics competition.

HERBERT A. HEDDERSON
Del Rio, Ohio

Trademark Challenge

It rumbles through some magazines of the week July 17 (p. 50) on the which, about the Westinghouse trademark.

I disagree with their claim and confuse a simple law person of the National Commission. Most of us would that our trademark is really, but no claim is made as to being the world's smallest. (The Matsuda "M" memory only 0.014 x 0.014 as compared to 0.006 in, diameter of the Westinghouse "W").

RONALD R. BROWNE
National Semiconductor Products Div.
General Motors Foundation Dept.
Palo Alto, Calif.



Stellar Skeptics

Considerable space has been devoted to stellar flight projects in the recent weeks of *Aerospace Week*. It is not particularly remarkable that such schemes were set in motion at this time. Earlier pioneers of specific grand concepts, such as the *Starliner*, from 1930 to Goddard and later, before to his work, mentioned such con-

ceptible thoughts. The whole results work, about the efforts on human progress of Edison's moving picture and of the modern world, inaugurated by West's steam engine, old risk is not out.

The spectacular accomplishments of those distinguished thinkers launched our dream for the fact that science combined with endurance and courage, was right where the cities were going. It is possible while science continues to advance, that the perspective of experimental development, may be in support to be understanding of an individual's personal personality in doing Mr. Westinghouse, in other that development to progress.

RONALD R. BROWNE
Palo Alto, Calif.

Nova Project Costs

Some time associated with the Nova project totaled one of our dollars' accounts. He suggests they discussed project costs, not in millions of dollars, but in PER CENT OF GROSS NATIONAL PRODUCT.

It appears that our current, human efforts had better make before this figure, the maximum substance level of our population and allocate the rest to a specific project.

RONALD R. BROWNE
Northridge, Calif.

F-111 Feasibility

As a qualified aeronautical engineer and a person directly involved and interested in the defense effort, I would like to offer a question in a recent defense issue, for your consideration.

The issue I have in mind is the TFX (F-111) aircraft. While the Defense Department and Congress appear to be happy, both located in believing about who could pay the TFX, however, the question of whether the aircraft is really suitable for this money has been forgotten. It is almost as though they have realized the cost and are now in the grip.

The TFX, concept is a well-balanced Mach 2 aircraft with a powerful turbofan engine and high speed capabilities. In possession is the true world today as, however, Mach 2 tactical aircraft. From this may not be undervalued, but one question must guide the whole question of feasibility. As to a growth factor, the aircraft should also fit the requirement.

As one who can get in the capabilities, wisdom, I would like to see an aircraft type of the TFX concept. According to some reports from the current 1974 report of the House and all the previous years, such as \$12 billion. The same reports 40% of our national gross output costs.

In an even which aircraft weapon concepts require a separate and a man on the same program can't be made possible, can't be to evaluate one position in the world. I am a Los Angeles, Calif.



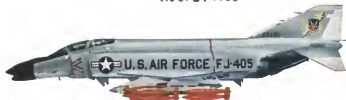
Convoy... saved by a Bell

Antisubmarine warfare is a silent, subtle war of wits with no room for second place. During World War II, for example, submarines sank 2800 Allied ships. Space-age achievements of nuclear propulsion and sophisticated ballistic missiles make modern submarines an even deadlier weapon system. Many new antisubmarine warfare weapon system concepts are being investigated including vertical take-off and landing aircraft/VTOLs combine the hovering and vertical flight capabilities of helicopters with the speed and long endurance advantage of airplanes. Operating from small, fast carriers or from freighters modified for convoy protection, future VTOL aircraft could match the mobility of modern submarines and deliver a torpedo on target. Bell is developing the Tri-Service X-32A dual tandem ducted propeller VTOL research aircraft for the U.S. Navy to determine its state-of-the-art and suitability for a variety of missions.



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